July 1951 Pages 253-296

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# Journal *of the* Y OF DYERS )LOURISTS

Volume 67 Number 7

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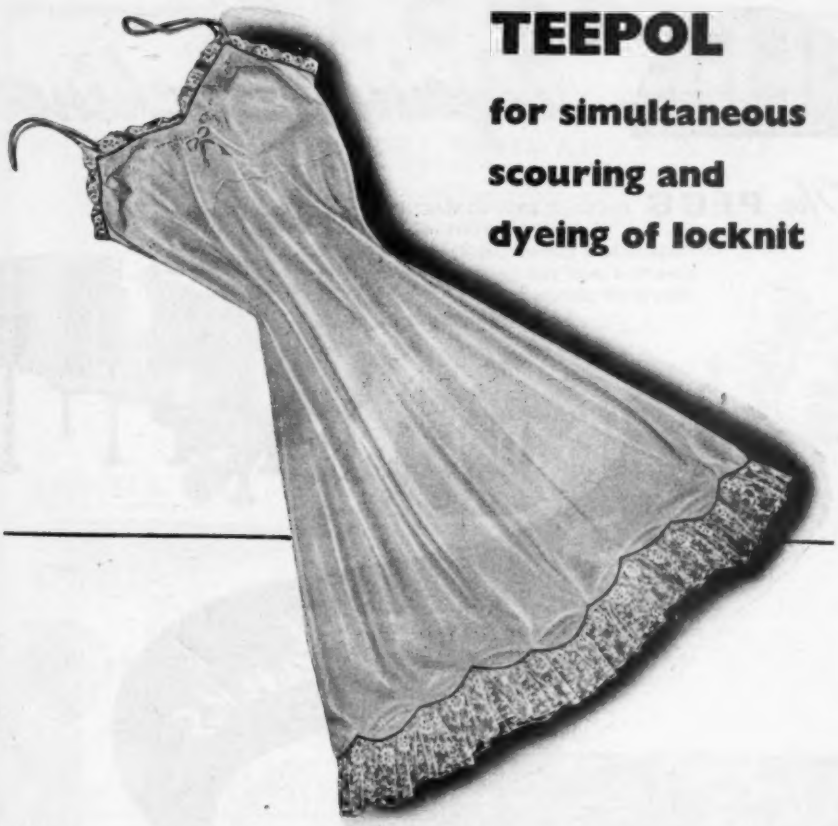

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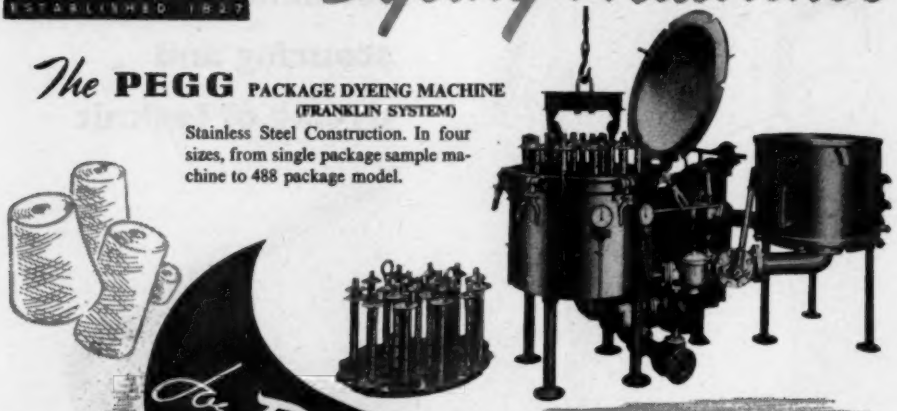

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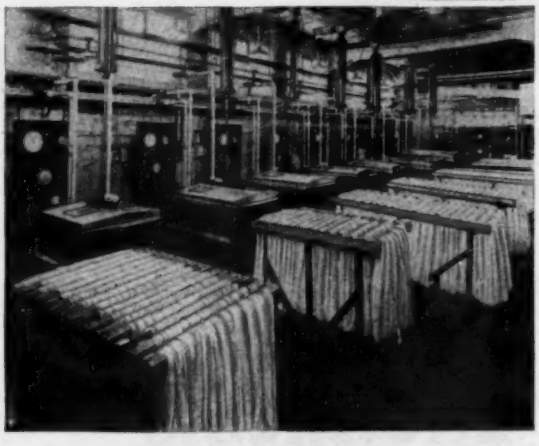

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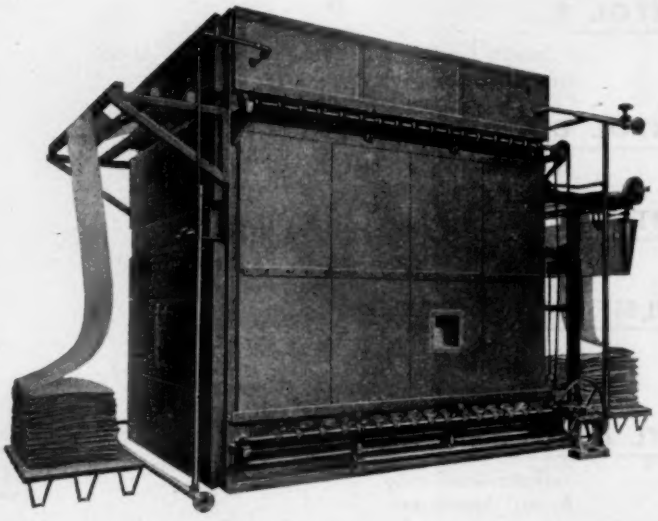

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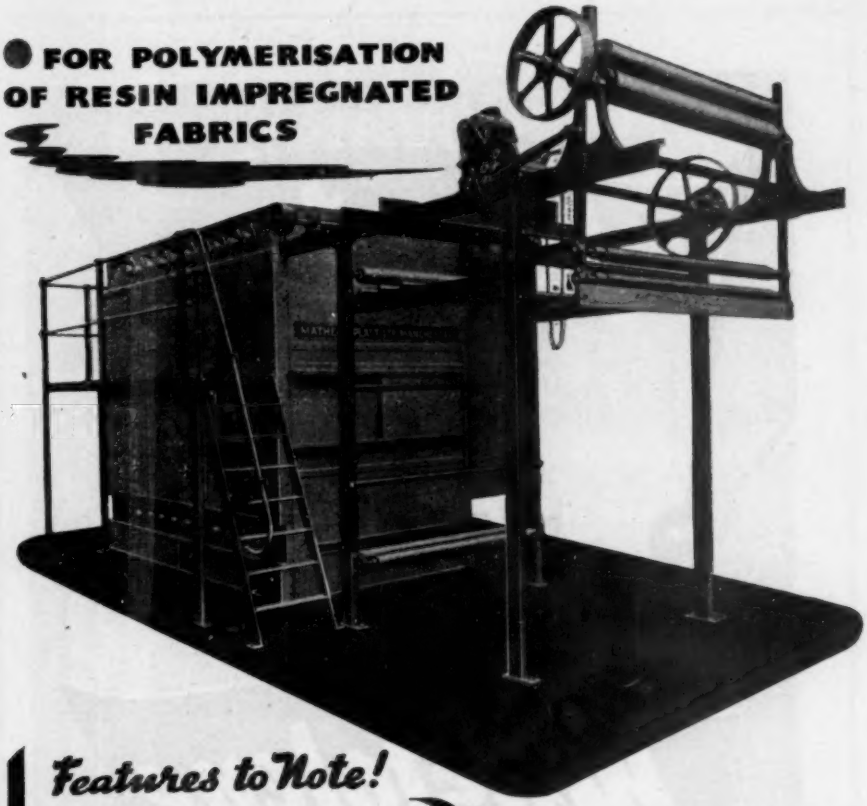

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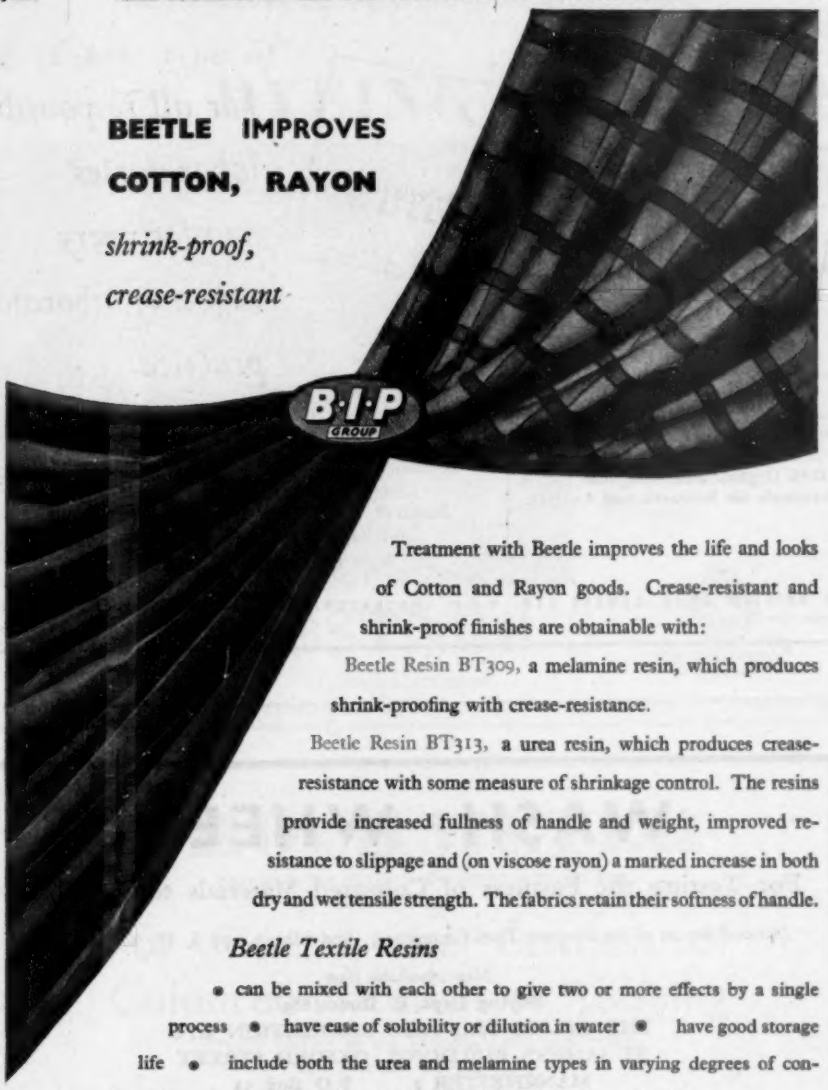


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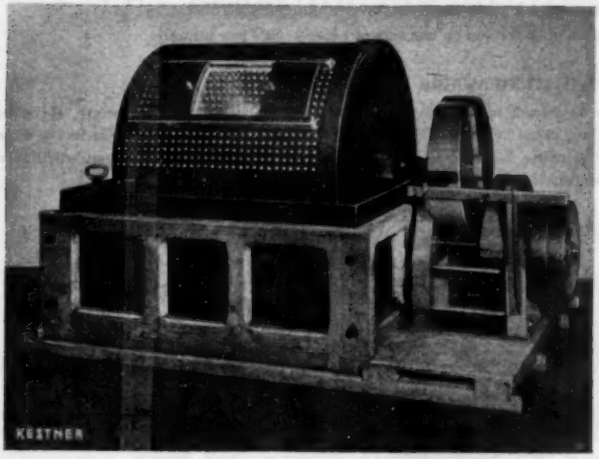


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## Forthcoming Papers

The following papers have been accepted by the Publications Committee, and will appear in future issues of the *Journal*—

LECTURES

Rayon Staple— A Dyeing Miscellany — *J. Boulton*

Causes of Unlevel Dyeing of Cotton Threads — *I. Gailey*

COMMUNICATIONS

Reduction of Direct Dyes during the Dyeing of Viscose Rayon — *W. Armfield*

Advances in the Application of Vat Dyes to Viscose Rayon Cakes — *H. Hampson*

The Colour of Organic Compounds— IV — *E. B. Knott*

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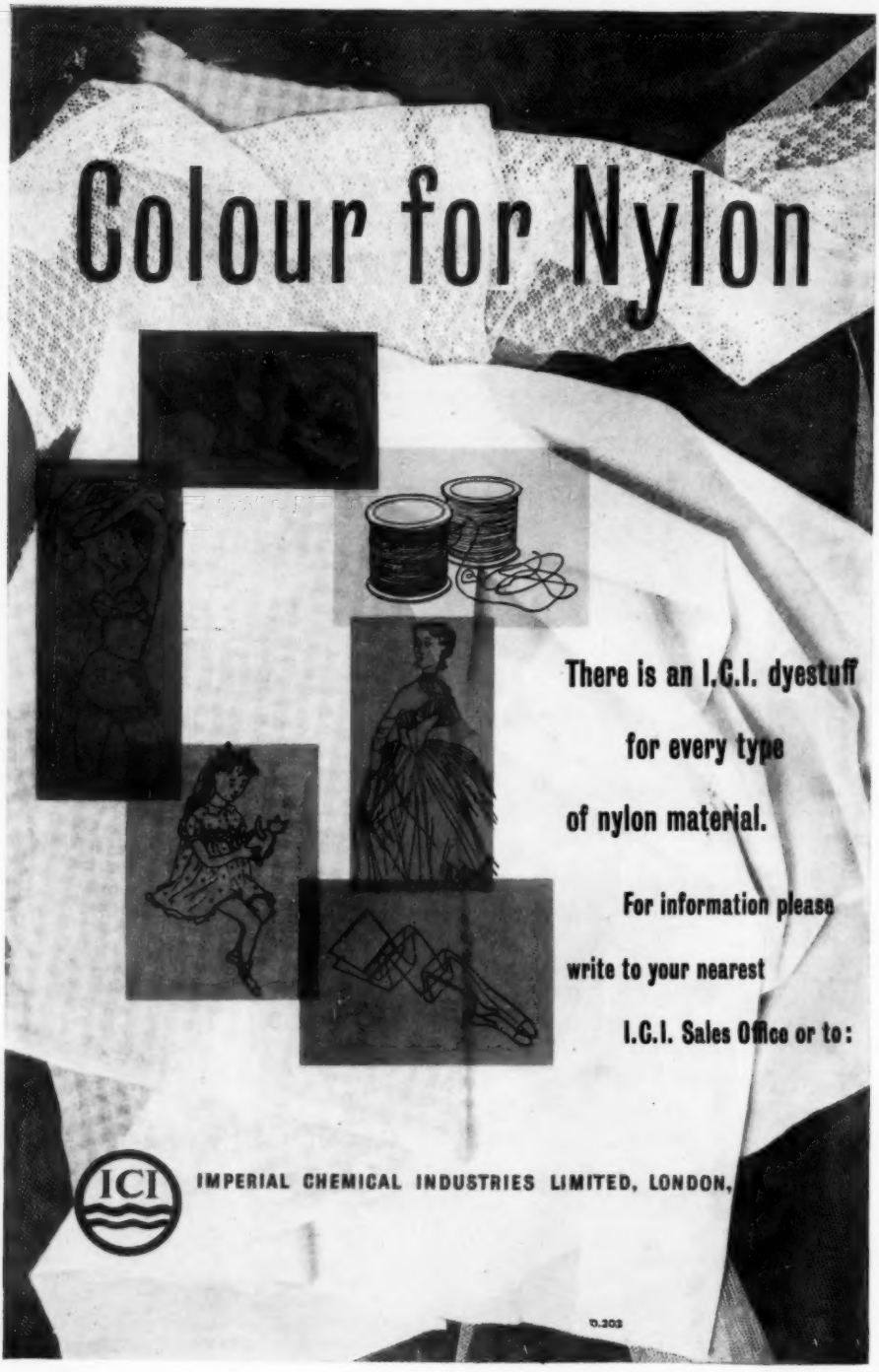
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# Proceedings of the Society

## The Eighth John Mercer Lecture

## Some Trials by Ingenious Inquisitive Persons: Regenerated Protein Fibres

DAVID TRAILL

*Meeting held at the St. Enoch Hotel, Glasgow, on 20th April 1951, Mr. F. Scholefield, President of the Society, in the chair*

> And I have often thought, that probably there might be a way found out, to make an artificial glutinous composition, much resembling, if not full as good, nay better, than that Excrement, or whatever other substance it be out of which, the Silkworm wire-draws his clew . . . . . This hint therefore, may, I hope, give some Ingenious inquisitive Person an occasion of making some trials . . . . . .[1]

The production of fibres by dissolving proteins and regenerating them in filamentous form is an old conception, although only recently has it been developed to a commercial scale. The idea of making synthetic fibres at all must have come from watching the spider or the silkworm extruding its filaments of fibroin. The first recorded suggestion is in Robert Hooke's *Micrographia*, published in 1664[1]. René Réaumur followed with a similar suggestion in his *History of Insects* in 1734[2], and in 1840 Louis Schwabe, a Manchester silk manufacturer, invented a machine for spinning synthetic fibres. His fibres were spun from glass, and he tried to enlist the aid of the British Association to assist him to find a substance with the right spinning properties which he might use as a starting material[3]. Unfortunately, he received no help, but he will be remembered as the first man to use a spinneret.

No solution was found to the problem of spinning a filament until cellulose nitrate had been discovered by Schönbein in 1846. Chardonnet patented the manufacture of synthetic fibres from cellulose nitrate in 1885, and exhibited a commercial product in Paris in 1889. Since then various other cellulose derivatives have been used as starting materials. In each case a soluble cellulose derivative is employed, for in solution the molecules are in a mobile state and can be rearranged in the form of a filament.

The same problem faces the experimenter when he uses a protein as the starting material, but before discussing the details of manufacturing fibres from proteins, let us first consider briefly the nature of proteins.

### The Nature of Proteins

Proteins have a very wide occurrence and are probably the most important substances occurring in living matter. The word *protein* is derived from the Greek word *proteios*, meaning "first", and was used by Mulder in 1839[4] to designate the nitrogen-containing substances that are found in all plant and animal tissues which are involved in vital phenomena. They are present in all plant and animal cells, the kind and amount varying with the particular cell in question. So universal is their distribution that all animals eat them when consuming any naturally occurring foodstuffs such as grass, beans, peas, milk, fish, meat, eggs, etc. By suitable application of nitrogenous fertiliser in Spring, grass with crude protein content as high as 19·7%, when dry, has been grown. Enzymes, bacteria, viruses, some hormones, and various other complex substances, essential to living matter, are all proteins.

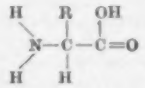
In the manufacture of textiles, protein fibres have been used for thousands of years in the form of the natural fibres, silk and wool.

The classical work of Emil Fischer, Abderhalden, and their collaborators has established that proteins are essentially organised polypeptide chain systems built up by the union of $\alpha$-amino acids.

The general formula for $\alpha$-amino acids is—

$$NH_2{\cdot}CHR{\cdot}COOH$$

or



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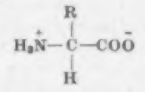


since they exist in aqueous solution as zwitterions. These amino acids, with the exception of proline and hydroxyproline, contain at least one amino and at least one carboxyl group, a basic group and a carboxyl group being attached to the same carbon atom. Twenty-two amino acids have been identified as constituents of proteins[5], and there are probably a few more. They vary greatly in nature according to the identity of the radical R.

By linking three amino acids together, with the elimination of two molecules of water, we get a tripeptide—

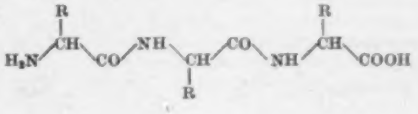


TABLE I

**Amino-acid Composition of Proteins**

(Ordinary figures ... g. of amino acid per 100 g. of protein)
(*Italic figures* ... ... *moles of amino acid per $10^5$ g. of protein*[8])

| Nature of Groups | Protein | Amino Acid R·CH(NH$_2$)·COOH | R | Spider Silk Fibroin[9] | | Silk (fibroin)[10] | | Wool (keratin)[11] | | Casein[9] | | Groundnut (arachin)[12] | | Soya (glycinin)[9] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total nitrogen | | | — | | 18·34 | | — | | 15·65[12] | | 17·5 | | — | |
| INACTIVE | Glycine | | H· | 35·1 | *467* | 43·8 | *584* | 6·5 | *87* | 1·9 | *25* | — | | 0·23 | *3* |
| | Alanine | | $CH_3$· | 23·4 | *263* | 26·4 | *296* | 4·1 | *46* | 3·5 | *39* | 3·0 | *34* | 4·12 | *46* |
| | Valine | | $(CH_3)_2CH$· | — | — | 3·2 | *27* | 5·5 | *47* | 6·02 | *51* | 3·38 | *29* | 4·50 | *38* |
| | Leucine | | $(CH_3)_2CH·CH_2$· | 0·8 | *6* | 0·8 | *6* | 9·7 | *74* | 10·55 | *80* | 6·5 | *50* | 8·40 | *64* |
| | *iso*Leucine | | $CH_3·CH_2·CH(CH_3)$· | | | 1·37 | *10* | — | — | 5·27 | *40* | — | — | 4·00 | *31* |
| | Proline |  | | 3·7 | *33* | 1·5 | *13* | 7·2 | *63* | 10·54 | *92* | 5·3 | *46* | 3·94 | *34* |
| | Hydroxyproline* | | | — | — | — | — | — | — | — | — | — | — | — | — |
| | Phenylalanine | | $C_6H_5·CH_2$· | — | — | 1·5 | *9* | 1·6 | *10* | 6·46 | *39* | 4·7 | *29* | 5·30 | *32* |
| ACIDIC | Aspartic acid | | HOOC·$CH_2$· | — | — | 2·0 | *15* | 7·27 | *55* | 6·70 | *50* | 14·95 | *112* | 3·86 | *29* |
| | Glutamic acid | | HOOC·$CH_2·CH_2$· | 11·7 | *80* | 2·03 | *14* | 16·0 | *109* | 22·03 | *150* | 21·1 | *143* | 19·46 | *132* |
| | Hydroxyglutamic acid | | HOOC·$CH_2$·CH(OH)· | — | — | — | — | — | — | — | — | — | — | — | — |
| | Ammonia | | | 1·16 | — | 0·00 | — | 1·18 | — | 1·41 | — | 2·16 | — | 2·02 | — |
| | (*Acid amide groups*) | | ·CO·$NH_2$ | — | *65* | — | *0* | — | *69* | — | *83* | — | *127* | — | *119* |
| BASIC | Hydroxylysine | | $NH_2·CH_2·CH(OH)·CH_2·CH_2$· | — | — | — | — | 0·1 | *1* | — | — | — | — | — | — |
| | Lysine | | $NH_2·CH_2·CH_2·CH_2·CH_2$· | — | — | 0·86 | *6* | 2·5 | *17* | 8·25 | *56* | 3·28 | *23* | 5·40 | *37* |
| | Arginine | | $NH_2·C(:NH)·NH·CH_2·CH_2·CH_2$· | 5·2 | *30* | 1·05 | *6* | 8·6 | *49* | 3·94 | *23* | 13·1 | *77* | 5·80 | *33* |
| | Histidine | | | — | — | 0·47 | *3* | 0·7 | *5* | 3·24 | *21* | 2·33 | *15* | 2·30 | *15* |
| HYDROXYL | Serine | | HO·$CH_2$· | — | — | 12·6 | *120* | 9·5 | *90* | 5·87 | *56* | 6·37 | *61* | 6·00 | *57* |
| | Threonine | | $CH_3·CH(OH)$· | — | — | 1·5 | *13* | 6·6 | *55* | 4·53 | *38* | 2·91 | *25* | 4·00 | *34* |
| | Tyrosine | | (*p*)HO·$C_6H_4·CH_2$· | 8·2 | *45* | 10·6 | *59* | 6·1 | *34* | 6·28 | *35* | 6·0 | *33* | 4·30 | *24* |
| SULPHUR-CONTAINING | Cystine | | HOOC·CH($NH_2$)·$CH_2$·S·S·$CH_2$· | — | — | — | — | 11·8 | *49* | 0·40 | *2* | 1·58 | *7* | 1·00 | *4* |
| | Methionine | | $CH_3·S·CH_2·CH_2$· | — | — | — | — | 0·35 | *2* | 3·50 | *24* | 1·24 | *8* | 2·00 | *13* |
| OTHER | Tryptophan | | | — | — | — | — | 0·7 | *3* | 1·37 | *7* | 1·19 | *6* | 1·50 | *7* |
| | Total | | | 89·26 | | 109·70 | | 106·00 | | 111·76 | | 99·09 | | 88·13 | |

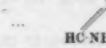
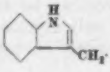
| Nature of Groups | Protein | Amino Acid R·CH($NH_2$)·COOH | R | Prolamines Zein[9] | | Prolamines Gliadin[9] | | Collagen[13] | | Gelatin[9] | | Egg Albumen[9] | | Insulin[13] | | Edestin[13] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total nitrogen | | | 16·2[12] | | 17·66[12] | | 17·9 | | 18·9[12] | | 15·76[12] | | 15·54 | | — | |
| INACTIVE | Glycine | | H· | — | — | 0·00 | *0* | 25·9 | *345* | 25·5 | *340* | — | — | 4·3 | *57* | 3·80 | *51* |
| | Alanine | | $CH_3$· | 9·80 | *110* | 2·0 | *22* | 9·1 | *102* | 8·70 | *98* | 2·22 | *25* | 4·6 | *52* | 4·31 | *49* |
| | Valine | | $(CH_3)_2CH$· | 3·98 | *34* | 3·34 | *28* | 3·3 | *28* | 0·0 | *0* | 2·50 | *21* | 7·49 | *64* | 4·75 | *41* |
| | Leucine | | $(CH_3)_2CH·CH_2$· | 15·40 | *117* | 6·62 | *50* | 5·35 | *41* | 7·10 | *54* | 10·71 | *82* | 15·68 | *120* | 12·13 | *93* |
| | *iso*Leucine | | $CH_3·CH_2·CH(CH_3)$· | 4·30 | *33* | | | | | | | | | | | | |
| | Proline | | | 9·00 | *78* | 13·22 | *115* | 14·6 | *127* | 19·7 | *171* | 4·15 | *36* | 2·56 | *22* | 3·56 | *31* |
| | Hydroxyproline* | | | — | — | — | — | — | — | 14·4 | *110* | — | — | — | — | 2·00 | *15* |
| | Phenylalanine | | $C_6H_5·CH_2$· | 7·60 | *46* | 2·35 | *14* | 4·0 | *24* | 1·4 | *9* | 5·07 | *31* | 8·09 | *49* | 5·94 | *36* |
| ACIDIC | Aspartic acid | | HOOC·$CH_2$· | 3·40 | *26* | 0·77 | *6* | 3·40 | *26* | 3·40 | *26* | 8·1 | *61* | 5·68 | *43* | 12·0 | *90* |
| | Glutamic acid | | HOOC·$CH_2·CH_2$· | 35·60 | *242* | 43·66 | *297* | 5·85 | *40* | 5·80 | *39* | 16·1 | *109* | 18·6 | *126* | 20·7 | *141* |
| | Hydroxyglutamic acid | | HOOC·$CH_2$·CH(OH)· | — | — | 7·70 | *47* | — | — | 0·00 | *0* | 1·36 | *8* | — | — | — | — |
| | Ammonia | | | 3·64 | — | 5·22 | — | 0·00 | — | 0·40 | — | 1·23 | — | 1·65 | — | 2·15 | — |
| | (*Acid amide groups*) | | ·CO·$NH_2$ | — | *214* | — | *307* | — | *0* | — | *24* | — | *72* | — | *39* | — | *126* |
| BASIC | Hydroxylysine | | $NH_2·CH_2·CH(OH)·CH_2·CH_2$· | — | — | — | — | 1·93 | *12* | — | — | — | — | — | — | — | — |
| | Lysine | | $NH_2·CH_2·CH_2·CH_2·CH_2$· | 0·00 | *0* | 0·69 | *5* | 5·88 | *40* | 5·92 | *41* | 4·97 | *34* | 2·44 | *17* | 2·37 | *16* |
| | Arginine | | $NH_2·C(:NH)·NH·CH_2·CH_2·CH_2$· | 1·60 | *9* | 2·57 | *15* | 8·1 | *47* | 8·68 | *50* | 5·66 | *33* | 3·0 | *17* | 16·71 | *96* |
| | Histidine | | | 0·80 | *5* | 3·30 | *21* | 0·85 | *6* | 2·94 | *19* | 1·48 | *10* | 4·88 | *31* | 2·88 | *19* |
| HYDROXYL | Serine | | HO·$CH_2$· | 1·00 | *10* | 0·13 | *1* | 3·00 | *29* | 3·3 | *31* | — | — | 5·18 | *49* | 6·32 | *60* |
| | Threonine | | $CH_3·CH(OH)$· | 2·20 | *19* | — | — | 2·28 | *19* | 1·4 | *12* | — | — | 2·08 | *18* | 3·85 | *32* |
| | Tyrosine | | (*p*)HO·$C_6H_4·CH_2$· | 5·90 | *33* | 3·04 | *17* | 0·00 | *0* | 0·00 | *0* | 3·97 | *22* | 13·03 | *72* | 4·34 | *24* |
| SULPHUR-CONTAINING | Cystine | | HOOC·CH($NH_2$)·$CH_2$·S·S·$CH_2$· | 0·91 | *4* | 2·40 | *10* | — | — | 0·17 | *1* | 1·78 | *7* | 12·5 | *52* | 1·44 | *6* |
| | Methionine | | $CH_3·S·CH_2·CH_2$· | 2·30 | *15* | 2·03 | *14* | — | — | — | — | 5·23 | *35* | — | — | 2·35 | *16* |
| OTHER | Tryptophan | | | 0·20 | *1* | 1·10 | *5* | 0·00 | *0* | 0·00 | *0* | 1·15 | *6* | — | — | 1·50 | *7* |
| | Total | | | 107·63 | | 100·14 | | 93·63 | | 108·81 | | 75·71 | | 111·79 | | 113·10 | |

TABLE I—*continued*

**Amino-acid Composition of Proteins**

(Ordinary figures ... g. of amino acid per 100 g. of protein)

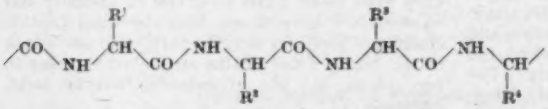
(*Italic figures* ... ... *moles of amino acid per* $10^5$ *g. of protein*[2])

| | Protein ... | Coconut globulin[2] | | Hæmoglobin (horse)[2] | | Serum Albumen[2] | | Salmine[2] | | Fibrin (cattle)[2] | | Leucosin (wheat)[14] | | Glutenin (wheat)[14] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total nitrogen ... | — | | — | | — | | — | | — | | — | | — | |
| Nature of Groups | Amino Acid R·CH(NH$_2$)·COOH R | | | | | | | | | | | | | | |
| INACTIVE | Glycine ... H· | Trace | — | — | — | — | — | — | — | — | — | 0·9 | *12* | 0·2 | *3* |
| | Alanine ... $CH_3$· | 4·11 | *46* | — | — | 2·68 | *30* | — | — | — | — | 4·5 | *51* | 4·7 | *53* |
| | Valine ... $(CH_3)_2CH$· | 3·57 | *30* | — | — | — | — | 4·30 | *37* | — | — | 0·2 | *2* | 0·2 | *2* |
| | Leucine ... $(CH_3)_2CH{\cdot}CH_2$· | 5·96 | *45* | — | — | 20·0 | *152* | — | — | — | — | 11·3 | *86* | 6·0 | *46* |
| | *iso*Leucine ... $CH_3{\cdot}CH_2{\cdot}CH(CH_3)$· | | | | | | | | | | | | | | |
| | Proline ...  | 5·54 | *48* | — | — | 1·04 | *9* | 11·0 | *96* | 5·1 | *44* | 3·2 | *28* | 4·2 | *37* |
| | Hydroxyproline* ... $CH_2{\cdot}CH(OH){\cdot}CH_2{\cdot}CH{\cdot}COOH$ | 2·05 | *15* | — | — | — | — | — | — | — | — | — | — | — | — |
| | Phenylalanine ... $C_6H_5{\cdot}CH_2$· | — | — | — | — | 3·08 | *19* | — | — | — | — | 3·8 | *23* | 2·0 | *12* |
| ACIDIC | Aspartic acid ... HOOC·$CH_2$· | 5·12 | *38* | 8·9 | *67* | 3·12 | *23* | — | — | 5·9 | *44* | 3·4 | *26* | 2·0 | *15* |
| | Glutamic acid ... HOOC·$CH_2{\cdot}CH_2$· | 19·07 | *129* | 6·3 | *43* | 1·52 | *10* | — | — | 14·1 | *96* | 6·7 | *46* | 25·7 | *175* |
| | Hydroxyglutamic acid HOOC·$CH_2{\cdot}CH(OH)$· | 0·00 | *0* | — | — | — | — | — | — | — | — | — | — | — | — |
| | Ammonia ... ... ... ... ... ... | 1·57 | — | 1·22 | — | 1·29 | — | — | — | — | — | 1·4 | — | 4·0 | — |
| | (*Acid amide groups*) ... ... ... ·CO·$NH_2$ | — | *93* | — | *72* | — | *76* | — | — | — | — | — | *82* | — | *235* |
| BASIC | Hydroxylysine ... $NH_2{\cdot}CH_2{\cdot}CH(OH){\cdot}CH_2{\cdot}CH_2$· | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| | Lysine ... ... $NH_2{\cdot}CH_2{\cdot}CH_2{\cdot}CH_2{\cdot}CH_2$· | 5·80 | *40* | 8·10 | *55* | 13·20 | *90* | — | — | 10·14 | *70* | 2·8 | *19* | 1·0 | *33* |
| | Arginine ... ... $NH_2C(:NH)·NH·CH_2·CH_2·CH_2$· | 15·92 | *92* | 9·59 | *21* | 4·90 | *28* | 87·4 | *501* | 7·70 | *44* | 5·9 | *34* | 4·7 | *27* |
| | Histidine ... ... ...  | 2·42 | *16* | 7·64 | *49* | 3·40 | *22* | — | — | 2·50 | *16* | 2·8 | *18* | 1·8 | *11* |
| HYDROXYL | Serine ... ... ... ... ... $HO{\cdot}CH_2$· | 1·76 | *17* | — | — | 0·8 | *6* | 7·80 | *74* | — | — | — | — | 0·7 | *7* |
| | Threonine ... ... ... ... $CH_3{\cdot}CH(OH)$· | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| | Tyrosine ... ... ... ... (*p*)$HO{\cdot}C_6H_4{\cdot}CH_2$· | 3·18 | *17* | 3·15 | *17* | 4·79 | *26* | — | — | 6·5 | *36* | 3·3 | *18* | 4·6 | *25* |
| SULPHUR-CONTAINING | Cystine ... ... HOOC·$CH(NH_2){\cdot}CH_2{\cdot}S{\cdot}S{\cdot}CH_2{\cdot}CH(NH_2){\cdot}COOH$ | 1·46 | *6* | 1·02 | *4* | 5·71 | *24* | — | — | 1·51 | *6* | — | — | 1·8 | *8* |
| | Methionine ... ... ... ... $CH_3{\cdot}S{\cdot}CH_2{\cdot}CH_2$· | — | — | — | — | — | — | — | — | 2·59 | *17* | — | — | — | — |
| OTHER | Tryptophan ... ... ...  | 1·25 | *6* | 1·28 | *6* | 0·53 | *3* | — | — | 3·0 | *15* | — | — | 1·6 | *8* |
| | Total ... ... ... ... ... ... | 78·78 | | 41·2 | | 65·86 | | 110·5 | | 59·04 | | 50·2 | | 66·8 | |

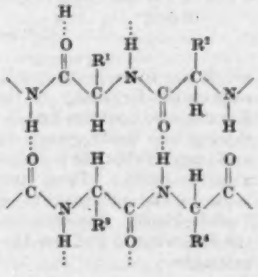
*OH at $CH_2$*

of which one terminal group is basic and the other acidic— in other words, an *ampholyte*. Proteins are formed by the linking of larger numbers of amino acids, the molecular chain being known as a *polypeptide* and being amphoteric in nature.

The nature of the polypeptide chain, which in the fully extended form may be written—



depends on the side-chains $R^1$, $R^2$, $R^3$, $R^4$, etc. In this stretched position the main polypeptide chains are held together by hydrogen bonds, between the hydrogen and the oxygen atoms of adjacent chains—



Such a regularity, of course, does not occur in natural or manufactured fibres.

As a result of these diverse side-chains, proteins are variable in form and versatile in character. Only some twenty-five of these side-chains are known, and yet, as Astbury has pointed out [6], "by virtue of their different sizes, shapes, mobilities, and chemical functions they have apparently sufficed for all the proteins in life". As mentioned earlier, there may be some twenty-five of these amino acids (twenty-two are definitely known), but this, of course, is sufficient to give rise to an astronomic number of polypeptides because of the various arrangements possible. In comparison, the cellulose molecule, made up of anhydroglucose residues, is simple. Likewise the functions of the various forms of cellulose in Nature are simple compared with the functions of the proteins.

Most proteins which we encounter in industry do not consist of the extended polypeptide chains shown in the conventional formula above, but are more compact, in the molecular sense, and

occur in Nature in a globular form. The usual conception is that the polypeptide chains are maintained in a specific coiled configuration by interaction amongst the numerous polar groups. These we refer to as *globular* proteins. On the other hand, some natural proteins are fibrous in their native form, e.g. silk and collagen.

The last ten to fifteen years has been a period of great activity in protein chemistry, in which many tentative theories have been advanced regarding protein structure, but nearly all have had to be rejected. Indeed, all we can cling to with any degree of certainty is Fischer's famous deduction, made at the beginning of this century, that proteins consist of a chain of amino acids joined by the peptide link. There is some evidence that many proteins are built up of a number of polypeptide chains linked together in a manner not definitely known. A layer structure is in accord with much of the evidence [7].

A knowledge of the amino acid composition of a protein does not take us far. The identity, number, and arrangement of these amino acids in the molecule probably determine the properties of the protein. There is much to be done to elucidate protein structure, and many tasks lie ahead for heroic experimenters.

## The Natural Protein Fibres

The natural protein fibres used in textiles fall into two classes— those based on fibroin, such as the silks; and those based on keratin, such as wool, cashmere, mohair, etc. These proteins were created by Nature for protective purposes, and are more inert and more stable than the normal soluble proteins. Those two classes differ very much in character, so let us glance quickly at our knowledge of those two fibrous proteins.

The amino acid distribution of various proteins is given in Table I.

### SILK FIBROIN

Looking first at the molecular structure of silk fibroin, it will be seen that some 70% of the amino acids per 100 g. of protein consists of glycine and alanine, the two simplest amino acids, in which the side-chains are –H and $-CH_3$ respectively. The main portions of the chain consist of glycyl, alanyl, and seryl residues. This means that the polypeptide chains which build up the bulk of the silk fibroin can pack closely together. During the extrusion of the fibroin from the silkworm's gland the molecules are uncoiled and straightened into extended polypeptide chains held together by hydrogen bonds, and so we have a strong fibre. Silk, however, contains 10·6% of the bulky amino acid tyrosine, which is unable to fit into the crystalline glycyl–alanyl–seryl regions and so forms amorphous regions in the structure of the silk molecule, which explains the elasticity of silk. We may picture the molecule as in Fig. 1 [15]. Meyer, Fuld, and Klemm [9] treated silk with diazobenzenesulphonic acid, which reacts only with the tyrosine groups, and found the space lattice of silk unaltered, confirming that the tyrosine groups lie outside the crystalline regions.

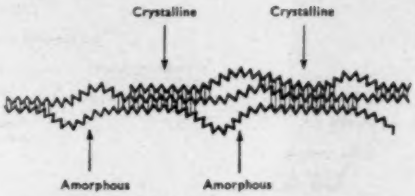


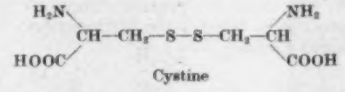

FIG. 1—Crystalline and Amorphous Regions of Silk (diagrammatic) [15]

Recent work by Howitt and his collaborators is in keeping with this view. An aqueous solution of silk fibroin can be obtained by dissolving the fibroin in cupri-ethylenediamine, neutralising, and dialysing. At pH 3 part is precipitated and part remains in solution. Coleman and Howitt [16] suggest that this water-soluble fibroin can exist in two forms— the denatured, in which the molecules of fibroin are in an extended chain configuration, and the renatured form, with the molecules folded around proline "hinges". Subsequent partition-chromatographic work by Drucker and Smith [17] has proved this.

Viscosity measurements indicate that the molecular weight of this precipitate, composed entirely of the three simple amino acids, is around 7,000. The weight of the bulky amino acids per molecule totals about 10,000. Drucker and Smith therefore deduced that, in fibroin of molecular weight around 33,000, there can be three straight-chain sections containing only glycine, alanine, and serine, linked by two regions containing all the bulky amino acids.

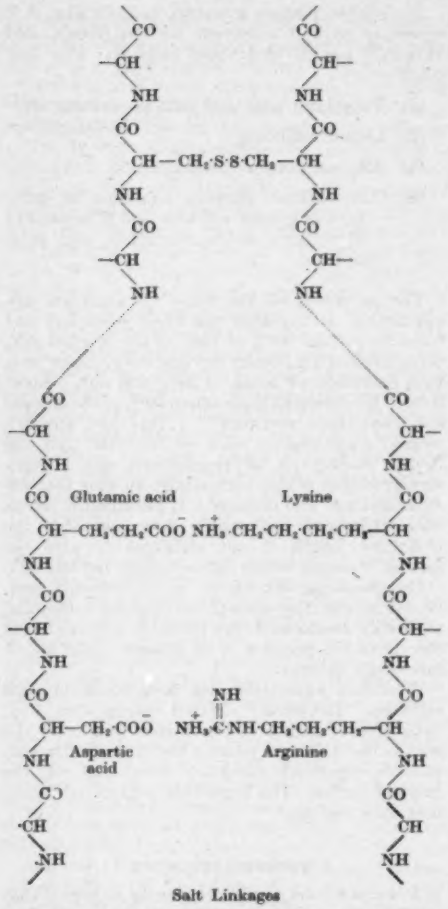
### THE KERATIN MOLECULE

The eighteen amino acids which are contained in wool (see Table I) show that the molecular shape of keratin must be very different from that of silk fibroin. The constitution of wool, in terms of the amino acids it contains, is known with fair precision, and the unit molecular weight is stated to vary from about 2,000 to 12,000 [11]. Astbury and co-workers [13] have shown that the main peptide chains are arranged roughly parallel to the length of the fibre. These chains are linked together in one plane by the diaminodicarboxylic acid, cystine—

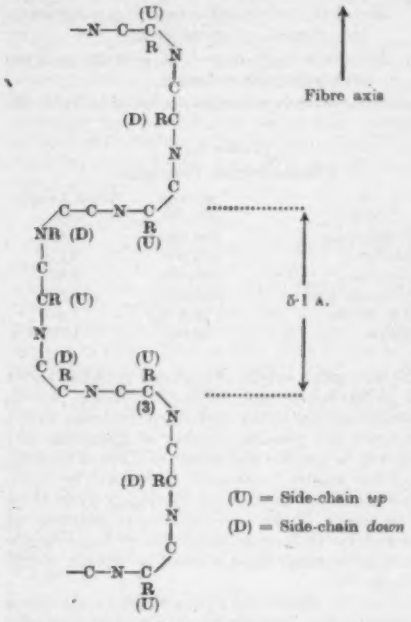



Cystine

which has roots, so to speak, in two chains and is responsible for many of the properties of wool. Keratin also contains two α-amino acids each containing two basic groups— arginine and lysine— and two dicarboxylic α-amino acids— glutamic and aspartic acids. These provide further bridges between the polypeptide chains in the form of "salt linkages". Speakman has therefore suggested the following to indicate the nature of the keratin molecule—




The peptide chains do not lie flat in the plane of the paper as suggested above, but have been shown by Astbury and Street [12] to be folded at right-angles to the paper, thus—




Micelles are made up of several of these folded grids superimposed in layers held together by hydrogen bonds, van der Waals forces, and cross-linkages.

Different wools vary slightly in composition and the sulphur content of a single wool fibre varies along its length, owing to differences in nutrition as a result of varying rainfall and the effect of light and air. Likewise the protective scales on the outer layer of wool either do not contain histidine and tyrosine or, if they do, have them combined in a different way from in the cortex.

## General Method of Preparing Regenerated Protein Fibres

Silk and wool, although both produced by natural processes, are therefore very dissimilar in character. In forming keratin fibres Nature has the advantage of time and can lay down the molecules slowly, in such a position as to give fibres affording the necessary properties for protection, etc. The chemist manufacturing a fibre has to work quickly and extrude filaments at a considerable speed. The yield of keratin from a sheep is relatively small, a few pounds per year according to the type of sheep, and a poor return on the protein ingested, but, of course, the sheep uses the vegetable protein which it eats for other purposes as well as the production of wool. This leads to the idea, however, of transforming some of the proteins available in the world into filaments without the medium of the animal. The possible proteins for such experiments include—

(*a*) Waste silk and wool

(*b*) Animal proteins such as casein, keratin in the form of hooves, feathers, slaughter-house waste, etc.

(*c*) Vegetable proteins.

In attempting this work there are certain relevant principles about fibre-forming polymers which have been laid down by the pioneers—Carothers, Staudinger, Mark, and Astbury. These experimenters have discovered that to have fibre-forming properties a polymer must—

(1) Consist of large molecules of molecular weight not less than 12,000 and molecular length not less than 1000 A.

(2) Be capable of crystallising and give a reasonable degree of orientation.

(3) Possess a high degree of polarity to give intermolecular cohesion.

Examples of such polymers are listed in Table II.

TABLE II

**Fibre-forming Polymers**

| Polymer | Average Mol. Wt. | Chain Length (A.) |
|---|---|---|
| Polystyrene ... | 600,000 | 15,000 |
| Rubber ... ... | 125,000 | 8,100 |
| Cellulose ... ... | 120,000 | 3,900 |
| Cellulose acetate ... | 103,000 | 1,900 |
| Silk fibroin ... ... | 33,000 | 1,400 |
| Nylon ... ... | 13,000 | 1,000[18] |

The molecular weight of globular proteins varies from 15,000 to several millions[19]. If the protein molecules are uncoiled and fixed in some linear form, then the possible number of intermolecular bonds will be greater and so the chances of forming a fibre are greatly increased. Care must be taken in this uncoiling to prevent too much hydrolysis, for the length of the extended linear polymer, as measured by molecular weight or average degree of polymerisation, must exceed a certain initial minimum [10,14].

In general, regenerated protein fibres are made by dissolving the protein starting material, usually in a dilute alkaline solution, and extruding through a spinneret into a coagulating bath. Thus far the process is similar to viscose spinning. The protein fibres, however, require a hardening or tanning treatment, in order to render them resistant to the wet processing which they encounter during dyeing, finishing, laundering, etc. There are exceptions such as regenerated silk, discussed later; here, as in regenerated cellulose, the cohesive force of the hydrogen bonds is sufficient to give the strength and the resistance required.

## Fibres from Animal Proteins

### REGENERATED SILK

Attempts to produce filaments of regenerated silk were inspired by the fact that waste silk was an economic starting material. Commercial attempts were first made by Magnier and Dörflinger [20] in 1879, and though numerous trials have followed none has achieved commercial success.

In the gland of the silkworm is secreted a fluid consisting of two proteins—fibroin and sericin. The silkworm extrudes twin filaments of fibroin embedded in sericin, but during the coagulation of the liquid, on extrusion, a curious phenomenon takes place and the solubility of the proteins is changed. Sericin becomes soluble in water but the fibroin insoluble, and this is generally regarded as being due to a process of denaturation. The cause of this change, which is similar to the coagulation of egg white on boiling, is uncertain.

In order to prepare a regenerated silk fibre it is necessary to find a solvent for the fibroin, and Howitt [21] has divided those employed into four types—

(1) Phosphoric acid and orthophosphoric acid

(2) Liquid ammonia

(3) Alkaline copper solutions

(4) Concentrated aqueous solutions of salts, such as halides, nitrates, and thiocyanates of lithium, sodium, calcium, and magnesium.

The properties of the fibres obtained are disappointing. In strength the fibres examined had fallen to around 30% of that of the original silk, being about 1·1 g./denier dry and 0·5 g./denier wet, with extension at break of 20% and 50% respectively. No strengths higher than 50% of the original silk have been reported [21]. This low strength seemed surprising in view of the fact that the X-ray photograph of regenerated silk is very similar to that of the original silk, showing that the molecules are well oriented. It presumably means that hydrolysis has taken place and that the molecular length is not sufficient to give the greater strength which characterises natural silk.

On dissolving silk fibroin in the solvents mentioned above, the amorphous regions containing the bulky amino acids are probably attacked, and the dissolved polymer is of shorter chain length but easily oriented.

A similar experience has been recorded with cellulose. Davidson [22] treated cotton with 10 N. hydrochloric acid, and found that long after the cotton had fallen to powder the X-ray diffraction pattern remained identical with that of the original cotton. The crystalline regions are therefore very resistant.

### REGENERATED WOOL

In earlier years, it was frequently suggested that waste wool might be spun into filaments. Failure to extrude dispersions of wool into fibres was attributed to the lowering of molecular size, by hydrolysis, when wool was dissolved in aqueous alkali. Methods of overcoming this have been found, and Wormell believes that the project is feasible [23].

A soluble protein is prepared by dissolving wool in aqueous sodium sulphide and precipitating at pH 4 with hydrochloric acid. The protein obtained is dissolved in cuprammonium solution, clarified, and precipitated at pH 3 with 10 N. sulphuric acid. The product is dissolved in cuprammonium solution at pH 8 to form a spinning solution with a solids concentration of 35%. The solution is extruded into a bath of sodium sulphate, and the filaments formed are hardened in two stages and finally insolubilised [24]. The fibre has a slightly oriented $\beta$-keratin structure when stretched in steam. The tenacity of the fibre is 1 g./denier dry and 0·3 g. per denier wet. Other starting materials suggested are rags, hooves, horns, and whalebone.

### REGENERATED EGG ALBUMEN AND FEATHERS

In America some work has recently been carried out by Lundgren and collaborators [25] using chicken feathers as a source of keratin and using synthetic detergents such as Nacconol (sodium alkarylsulphonate) to dissolve and denature the protein.

The Western Regional Research Laboratories in Albany, California, have studied the preparation of fibres from egg albumen and from chicken feathers, both being substances available in quantity in California, some 80,000 tons of chicken feathers and 13,000 tons of inedible egg white being available annually. They found that it is practicable to use certain detergents, already employed in protein adhesives, etc., as solvents, and that these have certain advantages for this work. Such synthetic detergents are good solvents for proteins and cause little, if any, degradation of the protein chains. These detergents loosen the attractive forces which hold the protein chains in a folded configuration and allow them to unwind. They form complexes, with both fibrous and globular proteins, which are easily precipitable into a suitable plastic state from which to draw fibres. The detergent can then be removed, and the protein chains drawn into alignment and held in their new highly oriented position by secondary or primary valency cross-linkages [26].

When native egg albumen is dissolved in an aqueous solution of some detergents to form solutions containing above 15% solids concentration, with the proportion of protein to detergent 3 : 1, the solution rises in viscosity and approaches a maximum, the rise in viscosity being accompanied by the development of streaming birefringence. This, of course, is characteristic of the unfolding of the protein chain. In contrast solutions of reduced chicken feather keratin in alkylbenzenesulphonates show birefringence immediately on preparation and show no significant change in viscosity with time.

Analysis of the electrophoretic patterns shows that addition of sulphonate to an excess of egg albumen results in the formation of a complex which has a constant ratio of protein to detergent of 3 : 1 and that this represents a definite combining capacity of the native protein for the detergent.

This complex, when precipitated by salts, is slimy and can be drawn into fibres. Viscous solutions of complexes in which the protein : detergent ratio lies between 40 : 60 and 60 : 40 (17% total solids) can be extruded through a spinneret into a coagulating bath of salt solution, and fibres, which can be stretched, are formed. In this state the fibres are weak, and even on stretching 100% the fibre is brittle.

The detergent can be removed with aqueous acetone (60% acetone), and orientation can be effected by stretching the fibres 300% in live steam. Extensions as high as 700% have been achieved. The fibres show positive birefringence and a high degree of molecular orientation.

Tensile strengths as high as that of silk have been claimed. No hardening treatment with formaldehyde is necessary, nor indeed does such a treatment increase the tensile strength. These fibres, however, swell and weaken in hot water, and in steam lose all effect of stretch. They have not been considered a commercial proposition.

Senti, Copley, and Nutting [26,27], using pastes of protein and water, extruded coarse filaments which, while weak and brittle initially, on stretching slowly in steam attained strengths as high as 30 kg./sq. mm. Attempts to obtain orientation without water failed. Such protein fibres contract considerably in water and so have no practical applications.

### REGENERATED GELATIN AND CASEIN FIBRES

The earliest of all regenerated protein fibres, and indeed one of the earliest of all manufactured fibres, was made from gelatin by Adam Miller in 1894 and called "Vanduara". At the beginning of the present century Todtenhaupt investigated the production of fibres from casein, the protein in milk, but without success. In 1935 a long research by Ferretti appears to have succeeded, where others failed, by careful control of pH, etc. during the preparation of textile casein. The Italian Lanital, however, suffered from the grave defect that it smelled of cheese when wet. Casein fibres have been made in various countries under diverse trade names— Aralac (U.S.A.), Caslen (U.S.A.), Lactofil (Holland), Cargan (Belgium), Tiolan (Germany), Silkool (Japan), Casolana (Holland), and Fibrolane (England).

Happey and Wormell [27] describe two methods for the production of casein fibre. For Fibrolane A the Ferretti [28] method is employed. In this process, the reduction in filament denier occurs during coagulation in a bath of sulphuric acid and sodium sulphate. The fibre is next washed in sodium chloride and treated with aluminium sulphate and formaldehyde. Final insolubilisation takes place in a solution of sodium sulphate, sulphuric acid, and formaldehyde. In producing Fibrolane B, Wormell [29] stretches the coagulated fibre 200% in hot liquor after a preliminary treatment with formaldehyde at pH 4–6, and finally insolubilises in an acid–formaldehyde liquor. Fibrolane B is rather stronger than Fibrolane A.

A further improvement in the strength of regenerated casein fibres is stated to be achieved by an aftertreatment of the finished fibre with metal salts, those of zinc being considered to be the most satisfactory.

## Regenerated Vegetable Proteins

Vegetable proteins seem a more reliable starting material. Because of their availability, soya beans, ground-nuts, maize and cotton seed have all been used and are all annual crops capable of being produced in larger quantities than at present. Soya beans and ground-nuts are grown for the oil which they contain and which has valuable uses in industry and in foodstuffs. Cottonseed oil is also important. The meals left after the removal of the oils are used as cattle food. Such commercial meals are normally unsatisfactory for fibre manufacture because they contain too much oil and because the oil has been removed at too high a

temperature [30,31]. Care must also be shown in the choice of a solvent for extracting the oil. Ethyl alcohol has a denaturing effect on the soya bean proteins, and reduces the total nitrogen peptised to 57% compared with 87% in the case of a hexane extraction [32]. Heat, however, appears to be the more important factor in reducing the amount of protein which can be extracted from the meal [33].

TABLE III

**Sources of Vegetable Proteins**

| Plant | Approximate Analysis of Seed (%) | | | Oil-free Meal Protein (%) |
|---|---|---|---|---|
| | Oil | Protein | Carbo-hydrates | |
| Soya bean ... ... | 16–19 | 35 | 45 | 40–45 |
| Ground-nut (decorticated) ... | 43–48 | 24–26 | 26–29 | 40–49 |
| Cottonseed ... | 36–38 | 29–32 | 34–36 | 40–45 |
| Maize ... ... | 4·5 | 10·5 | 70 | 11 |

Continuous extraction processes have now been worked out for the almost complete removal of oil from these seeds at any temperature. When preparing meal for fibre manufacture a lower temperature is employed than when the product is to be used for cattle food [34].

### ZEIN

As a starting material zein differs from soya protein and from ground-nut protein in several ways. The germ, containing 30–35% of oil, is removed from the maize seed, which is used principally for the production of starch, after the removal of which the residue, known as corn gluten, is practically all protein. Unlike most globulins zein cannot be extracted from corn gluten with dilute alkali. Zein is a prolamine, the only one of any substantial industrial interest, and is soluble in alcohol. It is extracted with *iso*propanol in a fairly pure condition.

Zein and its technical applications were studied at the Northern Regional Research Laboratories, Peoria, by Croston, Evans, and their collaborators. The work was carried to a commercial scale by the Virginia–Carolina Chemical Corpn., the fibre being called "Vicara". This fibre has a tensile strength of 1·0 g./denier dry and 0·45 g./denier wet. A grade of fibre specially suitable for admixture with animal fibres in hat manufacture is marketed under the trade name "Zycon".

### GROUND-NUT, SOYA-BEAN, AND COTTON-SEED PROTEINS

After the removal of the oil from the seeds, ground-nut meal and soya meal each contain around 45% of protein of similar nature. Work on the preparation of fibres from ground-nuts commenced in this country in 1935 and work on soya protein fibres was started by the Ford Motor Co. in 1939. It was taken over by the Drackett Co. in 1943, but does not appear to have left the development stage. Similar work has been carried out in Japan [35], but again there is no commercial production.

The isolation of the protein and the preparation of the fibre are very similar in the two cases now under discussion. The protein in these seeds varies according to the degree of maturity of the seed.

As a seed forms and ripens, a number of complex enzymatic processes occur, and some of these are concerned in the synthesis of proteins of various kinds from simple entities, initially amino acids. On germination there is usually a rapid breakdown of protein again to simpler molecules to supply the needs of the different parts of the plant. In general, the smaller the fragments into which protein molecules are broken, the more water-soluble they become and the less completely precipitable at their isoelectric point. This being so, it is obvious that to obtain a maximum yield of protein by an alkaline extraction followed by precipitation in the isoelectric range it is necessary, amongst other factors, that the seeds should be mature and ungerminated. Such seeds may be expected to yield to an alkaline extraction the maximum amount of precipitable protein (usually globulin and albumen) and the minimum amount of non-precipitable material.

Recent work has shown that these seeds do not contain a single protein but a family of several proteins. Electrophoresis experiments show that what was regarded as a single protein by Osborne and Campbell consists of several components [36]. Water extracts of oil-free soya-bean meal have been found to contain at least seven electrophoretically distinct proteins [36].

Salt fractionation has been used by Thomson [37] to divide ground-nut protein into three components, two of which are the previously recognised arachin and conarachin and the third is a fraction insoluble in 10% sodium chloride. Very considerable differences have been shown in the fibre-forming properties of the three fractions.

The main protein constituents of ground-nuts and soya beans being globulins, the choice of general methods of extraction and isolation is limited, and special modifications of these methods will depend on the behaviour of the globulins in the presence of the other components of the seed extracted along with them.

As a class plant globulins are soluble in water containing small amounts of salts or alkali. In the laboratory 5% or 10% sodium chloride is the usual extraction medium.

Such an extraction solution, however, is not adapted to large-scale working on economic grounds, because of the small amount of protein extracted. An alkaline extraction medium containing 0·1–0·2% sodium hydroxide has been found to extract a much greater proportion of globulin than 10% sodium chloride under otherwise identical conditions. Extractions with alkali have usually been looked at askance as causing great changes in the protein molecule, but according to Osborne [38] this effect probably has been greatly exaggerated. Such a verdict is largely confirmed by our experience in comparative experiments employing various extraction methods.

Precipitation of the protein may be effected in various ways. In saline solutions the methods adopted have been dialysis, dilution, addition of

ammonium sulphate to half saturation, addition of alcohol, and lastly acidification. While these methods are suitable for the laboratory, only acidification is practicable on a commercial scale.

The general method, therefore, is to extract the defatted meal with dilute alkali, carefully controlling the pH, filter, clarify, and isolate the extracted protein by reducing the pH of the extraction liquor to the isoelectric range of the mixture of globulins.

The insoluble residue remaining after extraction of the bulk of the protein, consisting of carbohydrates and protein with a nitrogen value of around 3%, is washed, dried, and used as cattle food.

An extraction of soya protein by means of sulphurous acid has been described, the advantage claimed being that the colour of the protein isolated is somewhat lighter [32]. The proteins extracted with sulphurous acid, and precipitated by bringing the pH to the isoelectric region by addition of caustic soda solution, contained 1·7–3·0% of phytic acid as an impurity which dialysis failed to remove.

In the case of casein precipitated from milk with acid or enzyme there is, of course, no residue, but the protein is treated similarly to the vegetable protein.

## Formation of the Fibre

The most practical method of forming a synthetic protein fibre is to extrude the protein in some fluid or plastic form through an orifice. Generally the protein is dissolved in caustic soda to form a viscous solution, but other solvents such as aqueous urea, ammonia, or synthetic detergents such as alkylbenzenesulphonates have been used. In the caustic soda process the alkaline protein solution is matured, by storing for about 24 hr. under well controlled conditions, to give a stable solution of suitable viscosity and spinning characteristics. These objectives are best achieved when the conditions of reaction give the maximum retention of long-chain molecules or molecular aggregates. Astbury has explained this rise in viscosity as due to denaturation.

For our purposes denaturation may be defined as being essentially a process by which the folded long-chain molecules present in the soluble protein are opened out into a more or less extended form. The viscosity of protein solutions depends on the shape of the dissolved particles. A study of the rheological conditions of solutions of ground-nut proteins in caustic soda confirms Astbury's hypothesis [39].

A convenient chemical criterion to determine denaturation is to measure the thiol (–SH) groups liberated [40]. An investigation of some globulins [41] showed that increased viscosity is associated with an increased capacity to reduce iodine, and was taken to indicate that by denaturation the molecular coils are loosened; the unfolded molecule, of course, is capable of more interactions than the more compact form, and so produces fibres with better mechanical properties.

The composition and the pH of the spinning solution must be carefully controlled. The protein content of the spinning solution depends on the protein used and varies from 12 to 30%. The pH of the spinning solution starts around pH 12 for the vegetable proteins and falls slightly during maturing. Casein solutions generally start at pH 9.

Such solutions are generally extruded into fibres by what is known as the "wet spinning" process. In this the protein solution is extruded through a spinneret at a constant rate into a coagulating bath. This spinneret is perforated with holes which vary in diameter according to the denier of filament required but are generally in the region of 0·07–0·10 mm. The coagulating liquor is usually a concentrated solution of sodium sulphate containing sulphuric acid and various spinning auxiliaries if required. The temperature may be between 12° and 40°C. The fibre at this stage is flabby when wet, soluble in dilute saline solution and in dilute acids and alkalis, and brittle when dry. It requires a further insolubilising, tanning, or hardening treatment to give it any practical value.

Instead of wet spinning some experimenters have preferred to use a "dry spinning" process, where the formation of the filament depends on the evaporation of the solvent [42]. In this process an alkaline solution of casein is extruded through orifices into warm air. The excess moisture evaporates, and silky filaments are obtained. These fibres, too, are soluble in water and so must be given a hardening treatment.

Other workers have introduced what is almost a method of melt-spinning proteins, and by the use of heat, water, and mechanical treatment have converted globular proteins into a fibre form giving an X-ray diagram nearly identical with that of $\beta$-keratin. This was done with egg albumen, casein, and vegetable seed globulins, the results being most striking with egg albumen.

Cotton seeds have been used as a source of protein by the Southern Regional Research Laboratories at New Orleans, and a fibre was announced in 1949 [43,44]. Some difficulty appears to be encountered in the preparation of the spinning solutions, which show a tendency to gel. The fibre is orange yellow in colour, and has a tenacity about half that of the ground-nut protein fibre.

The fibres manufactured in Britain from ground-nuts are Ardil (ICI) and, more recently, Fibrolane C (Courtaulds). In America the Southern Regional Research Laboratories called their fibre "Sarelon".

As far as can be ascertained, the last two fibres are still in the development stage, while the first is now in commercial production.

In all these spinning processes the fibre is stretched in the course of its formation to assist the alignment of chain molecules or molecular aggregates. The alignment obtained is nothing like that achieved by Nature in the case of silk fibroin, and is less even than the alignment in stretched wool.

Some workers use a different approach to the spinning of zein solutions. Swallen [45] makes a spinning solution using dilute caustic soda, but a small quantity (0·5–1% on the protein) of a

denaturant such as alcohol or urea is generally added. The protein concentration is usually 12–20% at pH 12, and the spinning solution also contains about 2% formaldehyde [46]. The addition of urea or alcohol reduces the ageing time. Almost any acid coagulant can be used.

## Hardening or Tanning

### REACTION WITH FORMALDEHYDE

The final and most important [20] stage in the manufacture of a regenerated protein fibre is the insolubilising or hardening of the fibre. Regenerated protein fibres treated with formaldehyde solution by normal tanning methods are not resistant to the various wet processes, dyeing, etc. which fabrics encounter. The early fibres from gelatin and casein were found unsatisfactory in this respect. Modern techniques use vigorous formaldehyde tanning, chrome tanning and the like, and also deamination, acetylation, or combinations of these to give fibres of agreeable softness and handle when dry, combined with chemical insolubility and water resistance. In commercial practice insolubilisation is nearly always achieved with formaldehyde under acid conditions. Under alkaline conditions formaldehyde is bound by the protein, but the fibre is not effectively hardened to withstand acid dyeing.

Zein fibres are hardened by processes similar to those adopted for other vegetable protein fibres. With zein, increased acid concentrations have been shown to promote the formation of acid-stable linkages. A stabilisation of zein in non-aqueous media [47] is stated to give remarkable resistance in acid and alkaline media.

The reaction of formaldehyde with proteins has been reviewed [8,48], and consideration given to the groups which may react, i.e. the functional groups containing active hydrogen atoms.

In Table I are collected the latest figures which have been given for the amino-acid distribution in a number of proteins. The amino acids are divided into various groups —

(1) Those with no side-chains or non-polar side-chains, which are therefore inactive
(2) Those with free carboxylic side-chains and amide side-chains — the dicarboxylic amino acids
(3) Those with basic side-chains — the diamino acids
(4) Those with side-chains containing a hydroxyl group
(5) Those containing sulphur
(6) Others, including histidine, tryptophan, proline, etc.

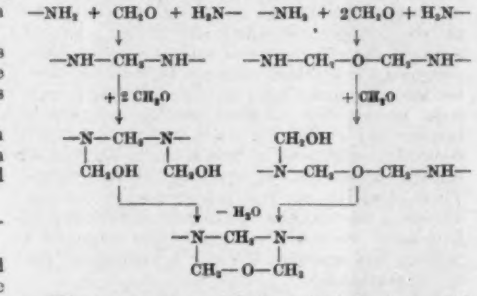
A comparison of the percentages of such amino acids in any particular protein is misleading, and in Table I a better comparison is gained from the italic figures giving the moles of amino acid per $10^5$ g. of protein. These figures show the outstanding contrast between the different proteins — the high amide content of zein, the basic nature and high arginine content of salmine, and so on. The action of any reagent, such as formaldehyde, on these proteins will therefore differ widely.

### *The Amino Group*

Bowes and Pleass [49] in this country, and Highberger and Retzsch [50] working independently in America, both showed that formaldehyde is probably bound by the amino groups of collagen. They compared the uptake of formaldehyde by collagen and by deaminated collagen at pH 7–8. The reasonable inference made is that under such conditions the formaldehyde is combined with the $\varepsilon$-amino group of the diamino acid lysine. The difference in the formaldehyde bound by native and by deaminated collagen is equivalent to the lysine content of native collagen. This disproves Gustavson's [51] assumption that the formaldehyde reaction results in a methylene link between two lysine amino groups. If there is a methylene link it must be between lysine and some other functional group, and it has been suggested that the peptide group is involved.

Wormell and Kaye [52] have studied the uptake of formaldehyde by casein at pH 4 and under more acid conditions. They find that the reaction at pH 4 proceeds at first fairly rapidly until bound formaldehyde reaches 2·6%, and then slowly for 4–7 days. They point out that, if it is assumed that the initial reaction is due to the combination of formaldehyde with lysine residues, then two molecules of formaldehyde combine with each amino group in the lysine side-chain.

The second reaction may be due to the formation of cyclic methylene complexes at points where the two amino groups are linked together —




When treatment with formaldehyde is carried out under salt–acid hardening conditions, the second reaction does not appear to take place. The same authors draw attention to Chibnall's suggestion [53] that proteins may, under certain conditions, dissociate into units of lower molecular weight. They suggest that the marked initial changes which take place when protein is treated with formaldehyde may be due to the linking up of such units by methylene or methoxymethylene links.

Nitschmann and Hadorn [54], working on casein, have also put forward the suggestion that a methylene link might be formed between the lysine free amino group and the peptide group by the action of formaldehyde. Their researches have been limited to reactions at pH 5–6. Again native and deaminated proteins have been studied. The lysine amino group plays a major part, and since

their experiments indicate that water is lost they infer that the formaldehyde forms a methylene link and not hydroxymethyl groups. The proportion of bound formaldehyde excludes the possibility of the linking of two lysine residues, and so Nitschmann and Hadorn deduce that the linking is essentially between lysine and peptide groups.

An alternative and more likely explanation is the linking of the lysine amino group to an amido group, and this is advanced by Fraenkel-Conrat and co-workers [55]. They treated a series of proteins, derived proteins, and polypeptides with 4% formaldehyde at 70°c. and pH 3·4–4·0. The amino nitrogen contents were reduced by 80–90%. The formaldehyde bound was in excess of the equivalent to the amino or even the total basic groups. A correlation was shown, however, between the sum of the basic and the amide groups of the proteins and the formaldehyde bound, and was regarded as suggestive evidence that the primary amide together with the basic groups are responsible for a great part of the aldehyde bound by the proteins under the above-stated conditions.

### *The Amide Group*

Wormell and Kaye [56] have found that casein treated with formaldehyde in the presence of acid and salts takes up twice the amount of formaldehyde bound under neutral conditions. If, however, the casein is deaminated, by treatment with 1% caustic soda at 45°c. for 40 hr., there is no difference in the quantity of formaldehyde bound under neutral and acid conditions. They conclude that at or near the isoelectric point formaldehyde combines with amino groups provided mainly by lysine residues, and under acid conditions it combines with amide groups provided by glutamic and related acid residues.

The following reactions may take place. One molecule of formaldehyde reacting with one acid amide residue would give—

$$-CO\cdot NH_2 + CH_2O \rightarrow -CO\cdot NH\cdot CH_2OH$$
$$\rightarrow -CO\cdot N{:}CH_2$$

This may be followed by some cross-linking—

(*a*) $-CO\cdot NH\cdot CH_2OH + HO\cdot CH_2\cdot NH\cdot CO- \rightarrow -CO\cdot NH\cdot CH_2\cdot O\cdot CH_2\cdot NH\cdot CO-$

or $-CO\cdot N{:}CH_2 + HO\cdot CH_2\cdot NH\cdot CO- \rightarrow -CO\cdot NH\cdot CH_2\cdot O\cdot CH_2\cdot NH\cdot CO-$

(*b*) $-CO\cdot NH_2 + HO\cdot CH_2\cdot NH\cdot CO- \rightarrow -CO\cdot NH\cdot CH_2\cdot NH\cdot CO-$

or $-CO\cdot NH_2 + H_2C{:}N\cdot CO- \rightarrow -CO\cdot NH\cdot CH_2\cdot NH\cdot CO-$

Tetlow [57] found that casein and ground-nut proteins when hardened under acid–salt conditions take up 2·7–3·1% formaldehyde. If such proteins are boiled in water for 60 min. the formaldehyde content is reduced to 1·7%. The most plausible explanation appears to be that the hydroxymethyl groups are removed under such conditions, and that the effective hardening of the protein is due to the formation of methylene links. Such links may be between amine and amide groups or between two amide groups. In the case of ground-nut protein hardened under acid–salt conditions, amine groups do not appear to feature in the linking, since deaminated ground-nut protein takes up the same amount of formaldehyde as native protein. Amide groups cannot be removed quantitatively, but partial removal results in a reduction of the formaldehyde uptake.

Haworth and co-workers [58] have now definitely proved that under alkaline conditions formaldehyde converts some of the amide groups of the ground-nut protein molecule into *N*-hydroxymethyl derivatives, but under acid conditions the number of such derivatives is reduced, probably because of the formation of methylenebisamide linkages.

When considering the action of formaldehyde on amide groups, one of the most interesting starting materials, of course, is zein, the protein from maize seeds. It contains no lysine and is therefore free from amino groups. It contains very little arginine but has a large proportion of amide groups. Consequently Wormell and Kaye found that zein treated with formaldehyde under neutral conditions combined with 0·4% formaldehyde, whilst under acid conditions it took up 4·1%. The hardening action of formaldehyde, with its marked increase in the strength of films and fibres, may therefore be due to the formation of methylene bridges between neighbouring amide groups or between amide and peptide groups.

This view is confirmed by the work of Evans and Croston [59]. They describe the method of curing zein fibres. A preliminary formaldehyde treatment or "pre-cure" is given in a bath containing 10% formaldehyde, 1% ammonium sulphate, and 5% sodium sulphate at pH 2–4. This is followed by an acetylation treatment, during which 30–50% of the formaldehyde which has been introduced is removed.

A second formaldehyde treatment or "pre-cure" involves the treatment of the fibre in 10% formaldehyde buffered to pH 1 by the addition of hydrochloric acid and ammonium chloride. The latter substances act as catalysts, and the optimum temperature is 60°c. The object of this second formaldehyde treatment is to confer acid dyebath resistance and to control the shrinkage, which is said to be a problem in zein fibres. There is a close relationship between this shrinkage and the loss of formaldehyde. This is interpreted as indicating that some of the formaldehyde must be in a cross-linkage liable to acid hydrolysis. Formaldehyde bound under acid conditions yields a fibre stable to acid and alkali.

### *The Peptide Link*

It has been shown by Fraenkel-Conrat and his co-workers [55] that silk fibroin, nylon, and polypeptides of glutamic acid or glycine bind very little formaldehyde, and the conclusion is drawn that peptide or secondary amide groups do not react with formaldehyde to any appreciable extent. This seems to ignore the fact that silk fibroin and nylon are both highly crystalline polymers, and that the strong lateral forces between the polypeptide chains could prevent the formation of methylene links. The possible reactions of the guanidyl and the hydroxyl groups, the disulphide bond, and the carboxyl groups have been discussed [8].

Summing up, therefore, it would seem that we have no definite proof of what happens when formaldehyde reacts with proteins. We know that the amino and the amide groups are certainly concerned, depending on the pH at which the reaction takes place. Other groups, such as the guanidyl, hydroxyl, and thiol groups, may be involved. We have no definite proof about the groups which take part in cross-linking. Under acid conditions the amide groups are definitely involved, and it is most probable that cross-linking takes place, forming a methylene link between amide and amide. Until recently, most of the work carried out on this old problem of tanning or hardening was of an empirical nature; at present, however, carefully planned researches with proteins and with model compounds are being carried out in various parts of the world, but as yet we are not very far forward. The work is very complex. Much of the difficulty is due to our limited knowledge of the proteins. We do not know what we are working with. The amino acid analyses are incomplete, and the results which have been obtained so far are not necessarily final. Stoichiometric calculations are inconclusive because of the large number of linkings which are possible.

ACETYLATION

Acetylation of proteins has been studied by various workers. One process involves treatment of a partly hardened filament with acetic anhydride or with keten at 80°C. or higher [60]. Acetylation has been used as a method of masking the basic groups in wool and decreasing its affinity for acid dyes. Silk fibroin has also been acetylated with keten, and an acetyl content as high as 7·3% has been reached, but there is a tendency for the fibroin to be discoloured brown. A study of the acetylation of casein fibres, carried out by Brown and co-workers [61], has shown that the acetyl content varies according to the conditions of acetylation and may be as high as 8·7%. Again the fibre is discoloured at the higher acetyl content. The degree of acetylation is not affected by acid catalysts but is increased with basic catalysts, and in such cases the tensile strength of the fibres is always decreased. The wet strength of casein fibres is not increased by acetylation, but the fibres are superior in resistance to acid dyebath conditions. They have also a greatly decreased affinity for acid dyes.

Acetylation is said by Evans and Croston [62] to modify the severity of the formaldehyde treatment and to result in various improvements in the fibre such as better colour, better handle, better water resistance, and improved dyeing properties.

DEAMINATION

Deamination by reaction with nitrous acid has been studied as a means of stabilising regenerated protein fibres with respect to wet processing [63,64]. Casein may be deaminated by nitrous acid before the preparation of the spinning solution, but the properties of the fibre are disappointing [65]. Covering or removing amino groups interferes with the hardening process. More successful results are obtained by deamination of a fibre which has already had a mild treatment with formaldehyde. Deamination causes yellowing, probably because of the reaction with tyrosine, but is stated to give increased resistance to acid dyebaths [65].

CHROME TANNING

The process of chrome tanning, used in tanning leather, has been applied to regenerated protein fibres. While satisfactory in resistance to wet processing, the fibre is so green in colour as to render it unsuitable for most textile purposes.

## Properties of Regenerated Protein Fibres

Regenerated protein fibres are usually circular in cross-section and vary in colour from pale cream to light brown. This colour is improved by a peroxide bleach.

Most regenerated protein filaments have been cut into staple fibre, in contrast to the continuous-filament viscose yarns, in which 25–40 continuous filaments are twisted together in the Topham box. The reason for this is that generally these protein fibres are being blended with wool, cotton, or some staple fibre on the machinery already existing in the textile industry. If produced in the form of a yarn from the Topham box they would need to be used as a 100% protein yarn, and for most purposes the strength is not high enough. A process has, however, been described [66], but it is doubtful if it is of any practical value.

The characteristic property of regenerated protein fibres is quite understandably the similarity to wool in warmth, handle, and resilience. Their anti-crease properties are higher than those of the regenerated cellulose fibres and approach those of wool. Generally, but not invariably, the fibres are crimped, which helps to include air in fabrics made from them and provides the heat insulation. It has been shown that in cloths of similar construction half the wool may be replaced by regenerated protein fibre without altering the thermal insulation [67].

Another important factor for certain textiles is the moisture absorption of these fibres, which is similar to that of wool and higher than that of cellulosic fibres. Like cotton and wool these regenerated protein fibres show hysteresis effects with water. This high moisture absorption together with high heat of wetting contributes very considerably to the warmth and comfort during wear of fabrics made from these fibres. The heat of wetting is similar to that of wool, as shown below in Table IV [68].

According to the efficiency of the hardening, the ease of hydrolysis of the protein is reduced, and as a result some of the protein synthetic fibres are rot-proof and mothproof to a marked degree.

By virtue of their chemical structure these protein fibres have an affinity for dyes normally used for natural protein fibres. Since their physical structure is not identical with the naturally occurring protein fibres, silk and wool, they do not possess the same dyeing properties as either of these fibres, but have their own individual characteristics intermediate between the two. In behaviour towards acid dyes they most resemble chlorinated wool, although they are not identical with it. They are dyed also to some extent by direct dyes.

TABLE IV
**Heat of Wetting of Fibres**[65]
(g. cal. per g. textile)

| | |
|---|---|
| Ardil | 27·41 |
| Wool (64s merino) | 27·00 |
| Viscose | 25·00 |
| Japanese regenerated silk | 19·83 |
| Fortisan (deacetylated cellulose acetate) | 18·00 |
| Cotton | 11·00 |
| Brig't nylon | 7·6 |
| Terylene | 1·36 |

These synthetic fibres made by extrusion have a smooth surface and thus will not felt like wool. This lack of felting reduces the milling shrinkage of fabrics made from these fibres. In spite of this lack of felting power, however, when mixed in quantities up to 25% with other animal hairs, felting is promoted, probably owing to the lubricating action of a proportion of smooth fibres.

Regenerated protein fibres have been used successfully in admixture with rabbit fur in hat manufacture. The scaly surface of the fur carries the protein fibre with it. A photomicrograph of a section of a hat containing Ardil fibre shows the protein synthetic fibre distributed evenly throughout the mixture.

## Textile Applications

A further difference from wool is that these fibres, being extruded as continuous filaments, may then be cut to any staple length and extruded in practically any diameter. They can therefore be prepared in any "quality" of wool, suitable for use on worsted and woollen machinery. But the length can also be set as short as cotton, and thus a uniform fibre can be prepared which can be used on cotton machinery. Protein synthetic fibres are complementary to the natural and other synthetic fibres, and can be mixed with them to produce desirable effects in cloths.

A most important property is their non-inflammability. They are no more inflammable than wool, and the insurance companies have recognised this.

Worsteds have been made by blending up to 50% of regenerated protein fibre with wool, and these cloths have behaved normally in processing and in wear. The mixture creases differently from all-wool, having a sharper crease, which is more noticeable but which comes out on standing overnight. Woollens with 25–30% regenerated protein fibre are to most people indistinguishable from all-wool. The blend is generally softer than all-wool, and this has been exploited in some velour cloths, where the silky softness and desirable bloom in the surface of the cloth are found to be particularly attractive.

Worsted yarns from these blends have been knitted into garments. Here, again, results have been satisfactory, except in some special knits, where a more elastic yarn than a 50 : 50 blend appears to be necessary.

In the applications described above the principal effect achieved has been an economic advantage. In Lancashire, however, the admixture of these regenerated protein fibres with cotton, viscose staple fibre, or cellulose acetate staple fibre leads to new textile effects. The protein fibre confers a fullness on the cellulose fibre, and improves the crease resistance of the cloth, the handle, and the drape. The blends have warmth, softness, and woolliness.

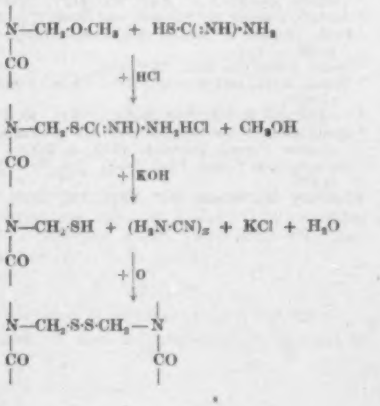
A generic name for such regenerated protein fibres is necessary for ease of parlance. Following the system already accepted, in which *rayon* covers the fibres from cellulose and cellulose derivatives, and *nylon* covers the polyamides, *azlon* has been suggested to cover the various regenerated protein fibres. It is unfortunate that the more euphonious term "prolon" has already been registered as a trade mark, and so is not available for this purpose.

## The Problem of Strength

While azlons as made at present have been used satisfactorily in the textile industry, there is no doubt that an improvement in tensile strength, particularly in the wet state, is desirable for certain purposes, and much research is being directed towards this end. It matters not what protein is used as starting material and how good is the degree of orientation. The tensile strength almost invariably is around 1 g./denier in the dry state and 0·3 g./denier in the wet state. In the case of regenerated silk the X-ray diagram is as good as that of the original material. No hardening treatment is given. The molecules in regenerated silk are therefore held principally by hydrogen bonds. Likewise in the work described on regenerated wool, even after stretching in steam and obtaining a fibre of the $\beta$-keratin type, the strength given was that already mentioned. It would seem, therefore, that orientation in itself is not enough, and possibly where these two fibres fail is in molecular length. Probably in the process of extraction and dissolution some hydrolysis has taken place.

An increase in strength might be obtained if we had more effective methods of cross-linking. So far, formaldehyde has been the material universally used. Other hardening agents or alternative conditions which make more effective use of formaldehyde may be discovered.

A method of preparing high polymers with a controllable number of cross-links between the chains has been described[69]. Thiourea reacts with *N*-methoxymethyl-66-nylon as follows—



In this way is introduced a linkage corresponding to the disulphide link due to cystine in wool, a linkage which plays a most important part in the properties of wool.

A method has been described[73] in which a regenerated protein fibre after receiving a hardening treatment with formaldehyde is stretched in a bath containing 3% mercuric acetate and 0·1 N. acetic acid at 70°C., and held in this position for 30 min. After washing and drying, this fibre is found to have increased in tensile strength to 15 kg./sq.mm. when dry and 9 kg./sq.mm. when wet. While the use of mercuric acetate has definite disadvantages, this gives a lead to the problem of cross-linking[71].

It would be unwise to predict the future of these regenerated protein fibres. A great impetus has been given to all manufactured fibres by the unprecedented rise in the prices of wool and cotton. The increasing population of the world and, more important, the increase in the standard of living, have created a demand for textile fibres which has been met only through the introduction of manufactured fibres into our everyday life. One of the outstanding technical achievements of this century has been the production of fibres on a cellulose basis, which now forms one of the major industries of the world. There appears to be a need for wool-like manufactured fibres, and their production from proteins has just started here and in other countries. The properties of the fibres leave room for improvement, but when we look back on the enormous improvements which have been made in regenerated cellulose fibres in the past thirty years, we may be encouraged to think that regenerated protein fibres may become different from those we now know.

Remember what Francis Bacon said of innovations—

> As the births of living creatures at first are ill-shapen, so are all innovations, which are the births of time . . . . .

## References


[1] Hooke (Curator of the Royal Society), "Micrographia" (London 1664).
[2] Réaumur, "Mémoires pour servir à l'Histoire des Insectes" (Amsterdam, 6 vol. 1734–42).
[3] British Association, *Report* (1842).
[4] Mulder, *J. prakt. Chem.*, **16**, 129, 138 (1839).
[5] Vickery, *Annals N.Y. Acad. Sci.*, **41**, 77 (1941).
[6] Astbury's essay in "Growth and Form", p. 314.
[7] Bull, "Outline of Amino Acids and Proteins" (1948), p. 83.
[8] Traill, *Chem. and Ind.*, 23 (1950).
[9] Meyer, Fuld, and Klemm, *Helv. Chim. Acta*, **23**, 1441 (1940).
[10] Sookne and Harris, *Bur. Stand. J. Res.*, **30**, 1 (1943).
[11] Speakman, "Fibre Science", edited by Preston (Manchester: Textile Institute 1949), p. 283.
[12] Astbury and Street, *Phil. Trans. Roy. Soc.*, **230A**, 75 (1931).
[13] Astbury and Woods, *ibid.*, **232A**, 333 (1933).
[14] Carothers and Hill, *J. Amer. Chem. Soc.*, **64**, 776 (1942).
[15] Howitt, "Fibre Science", p. 63.
[16] Coleman and Howitt, *Proc. Roy. Soc.*, **A 190**, 145 (1948).
[17] Drucker and Smith, *Nature*, **165**, 196 (1950).
[18] Taylor, *J. Amer. Chem. Soc.*, **69**, 635, 638 (1947).
[19] Svedberg and Pedersen, "The Ultracentrifuge" (1944).
[20] Magnier and Dörflinger, *G.P.* 7275 (1879).
[21] Howitt, "Bibliography of Silk" (London: Hutchinson's Technical & Scientific Publications 1946), p. 70.
[22] Davidson, *J. Textile Inst.*, **34**, T 87 (1943).
[23] Wormell, *ibid.*, **39**, T 219 (1948).
[24] Happey and Wormell, *ibid.*, **40**, T 855 (1949).
[25] Lundgren and O'Connell, *Ind. Eng. Chem.*, **36**, 370 (1944).
[26] Nutting, Senti, and Copley, *J. Amer. Chem. Soc.*, **15**, 343 (1943).
[27] Happey and Wormell, *Fibrous Proteins* (Bradford: the Society 1946).
[28] Ferretti, *B.P.* 483,731.
[29] Wormell, *B.P.* 502,710.
[30] Scott, *Chemurgic Digest*, **6**, 192 (1947).
[31] Traill and McLean, *J.S.C.I.*, **64**, 221 (1945).
[32] McKinney and Sollars, *Ind. Eng. Chem.*, **41**, 1058 (1949).
[33] Mann and Briggs, *Cereal Chemistry*, **27**, 258 (1950).
[34] Boyer, *Ind. Eng. Chem.*, **32**, 1549 (1930).
[35] Skigan Aralei, Kazuo, and Kinjiro Jzuck, *J. Soc. Chem. Ind. Japan*, **49**, 33 (1946).
[36] Mann and Briggs, *Cereal Chemistry*, **27**, 243 (1950).
[37] Thomson (in the press).
[38] Osborne, "The Vegetable Proteins" (London 1919).
[39] Thomson and Traill, *J.S.C.I.*, **64**, 229 (1949).
[40] Anson and Mirsky, *J. Gen. Physiol.*, **18**, 307 (1935).
[41] Jirgensons, *J. Polymer Sci.*, **3**, 635 (1948).
[42] Signer, *B.P.* 569,662.
[43] *Textile World*, **100**, 103 (1950).
[44] Arthur and Many, *Text. Research J.*, **19**, 605 (1949).
[45] Swallen, *U.S.P.* 2,156,929.
[46] Croston, Evans, and Smith, *Ind. Eng. Chem.*, **37**, 1194 (1945).
[47] Croston, *ibid.*, **42**, 482 (1950).
[48] French and Edsall, "Advances in Protein Chemistry", Vol. 2.
[49] Bowes and Please, *J. Soc. Leather Trades Chem.*, **23**, 365, 451 (1939).
[50] Highberger and Retzsch, *J. Amer. Leather Chem. Assocn.*, **34**, 131 (1939).
[51] Gustavson, *Kolloid-Z.*, **103**, 43 (1945).
[52] Wormell and Kaye, *J.S.C.I.*, **64**, 75 (1945).
[53] Chibnall, *Proc. Roy. Soc.*, **B 131**, 143 (1942).
[54] Nitschmann and Hadorn, *Helv. Chim. Acta*, **27**, 299 (1944).
[55] Fraenkel-Conrat, Cooper, and Olcott, *J. Amer. Chem. Soc.*, **67**, 950 (1945).
[56] Wormell and Kaye, *Nature*, **153**, 525 (1944).
[57] Tetlow, *J. Sci. Food Agriculture*, **1**, 193 (1950).
[58] Haworth, McGillivray, and Peacock, *J.C.S.*, 1493 (1950).
[59] Evans and Croston, *Text. Research J.*, **19**, 202 (1949).
[60] Traill and I.C.I. Ltd., *B.P.* 495,332 (1937).
[61] Brown *et al.*, *Ind. Eng. Chem.*, **36**, 1171 (1944).
[62] Evans, Croston, and Van Elten, *Text. Research J.*, **17**, 562 (1947).
[63] Jirgensons, *J. prakt. Chem.*, **160**, 120 (1943); **162**, 224, 237 (1943).
[64] Koch, *Chem. Weekblad*, **44**, 29 (1948).
[65] Peterson and McDowell, *Text. Research J.*, **20**, 95 (1950).
[66] Peterson, McDowell, and Hoover, *ibid.*, **18**, 744 (1948).
[67] Traill, *Chem. and Ind.*, 58 (1945).
[68] Dr. N. Bright (Research Laboratories, Nobel Division, I.C.I. Ltd.), Private Communication.
[69] Cairns, Gray, Schneider, and Schreiber, *J. Amer. Chem. Soc.*, **71**, 655 (1949).
[70] Traill, Simpson, and I.C.I. Ltd., *B.P.*639,342.
[71] Clegg, *Text. Merc. & Argus*, **124**, 185 (2nd Feb. 1951).

COMMUNICATION

# A Study of the Polymerisation of Methacrylamide in Wool

N. K. Boardman and M. Lipson

Methacrylamide has been found to have little affinity for wool, the maximum absorption from a 4% solution being equivalent to only 2·6% of the weight of wool. Absorption, which is initially fast, reaches equilibrium in about 16 hr. and is directly proportional to the molarity of the solution, the activation energy for a 4% solution being 800 g.cal./mole. As pretreatment of the wool with alcoholic alkali increases the rate of absorption, the rate-controlling process is probably diffusion through the fibre-surface. Wool containing polymethacrylamide shows an increased absorption-rate for monomer, the activation energy being 8000 g.cal./mole. Amounts of polymer considerably in excess of the maximum absorption of monomer can be formed in wool; to explain this, it is considered that there is a rapid replacement of monomer in the wool to compensate for that removed during polymerisation, and that this continues until polymerisation is terminated.

## 1. INTRODUCTION

It has been shown previously[1] that ethylenic monomers can be polymerised in wool from aqueous solutions using as catalyst free hydroxyl radicals produced by interaction of hydrogen peroxide and a ferrous salt. By this method, substantial amounts of polymer were synthesised within the fibre from aqueous solutions of methacrylic acid and methacrylamide respectively.

With methacrylic acid, the reaction was quite rapid, large quantities of polymer being deposited after a reaction-period of only 10 min.[1]. In agreement with this, the absorption of the monomer by wool was also observed to be extremely rapid and of sufficient magnitude to account for the substantial amounts of polymer formed.

With methacrylamide, large amounts of polymer could be produced only in longer time-periods, indicating either that absorption of the monomer was a slow process or else that its polymerisation in wool was slow. The purpose of the present investigation was to study in greater detail the absorption and polymerisation of methacrylamide in wool and to ascertain reasons for the above differences in behaviour.

## 2. EXPERIMENTAL

### (a) *Materials used*

The wool was prepared from the base of staples of a 70s merino fleece by successive extractions with ether (8 hr.), alcohol (6 hr.), and distilled water (six extractions at 50°C.). After purification, it was conditioned at 22°C. and 65% R.H., the equilibrium moisture content being 13%.

The methacrylamide, which was kindly supplied by Messrs. Imperial Chemical Industries Ltd., was recrystallised from ethyl alcohol before use. Care was taken to avoid excessive heating during recrystallisation, as this can cause polymerisation.

### (b) *Estimation of Methacrylamide*

After examination of several possible methods for estimating methacrylamide, it was found that the most reliable procedure was by bromine absorption from solution in carbon tetrachloride as outlined below. Similar methods have been previously described[2,3].

The solution to be analysed was suitably diluted so that a 20-ml. aliquot contained 0·1–0·3 g. of methacrylamide. To this was added 10 ml. of 10 N. hydrochloric acid followed by about 15 ml. of 0·3 N. bromine in carbon tetrachloride measured from a burette. (This concentration was used as the partial pressures of bromine and carbon tetrachloride were approximately equal under these conditions, and so no change in composition resulted from evaporation.) The tip of the burette passed through a cork, so that the flask containing methacrylamide was closed during addition of the bromine. The flask was stoppered and shaken until a permanent colour of bromine was obtained in the aqueous layer. After standing in the dark for at least 2 hr., excess potassium iodide was added and the solution titrated with 0·15 N. sodium thiosulphate with starch as an indicator

### (c) *Determination of Absorption*

Each sample of conditioned wool (1 g.) was placed in 70 ml.* of methacrylamide solution and wetted out *in vacuo*. It was then allowed to remain under the required conditions of time and temperature, after which a suitable aliquot was removed and diluted for analysis as described above. A control experiment without wool was undertaken simultaneously, the absorption being ultimately calculated from the difference between the two results. All experiments were done in duplicate.

### (d) *Polymerisation*

The conditions of polymerisation were similar to those previously described[1]—0·5-g. samples of wool were treated in 0·2% ferrous ammonium sulphate for 2 hr. at 25°C., and then at 50°C. in 10 ml. of monomer solution containing 1 ml. of 0·06% hydrogen peroxide.

### (e) *Treatment with Alcoholic Alkali*

The wool (1 g.) was treated with 100 ml. of 2% potassium hydroxide in 95% alcohol for 15 min. at 20–22°C., squeezed, and treated with 0·2 N. sulphuric acid for 10 min. Acid was removed with sodium carbonate solution followed by washing overnight in running water. The wool was then conditioned at 65% R.H. and 22°C.

## 3. RESULTS

### (a) *Absorption of Methacrylamide by Wool*

The results of these experiments are plotted in Fig. 1–3.

* 50 ml. in later experiments.

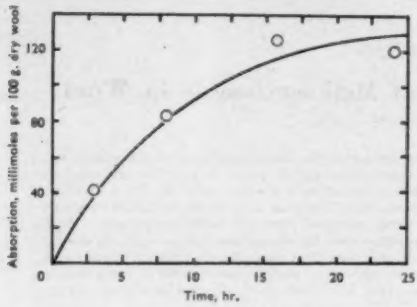



FIG. 1— Absorption of Methacrylamide by Wool from a 20% Solution at 50°c.

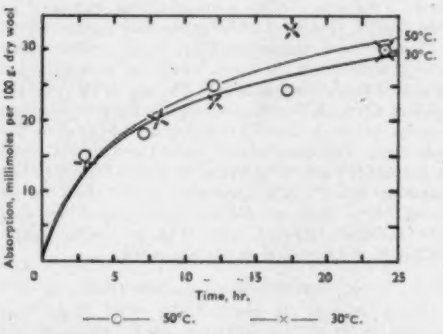



FIG. 2— Absorption of Methacrylamide by Wool from a 4% Solution

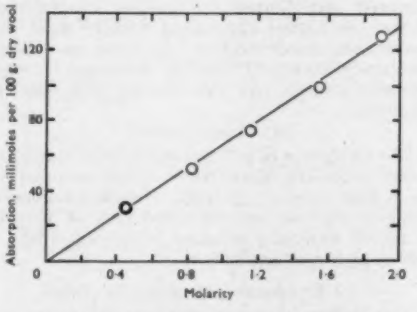



FIG. 3— Effect of Concentration of Solution on the Absorption of Methacrylamide by Wool at 50°c.

It is seen that the monomer has little affinity for the wool, the small amount of absorption which occurs reaching equilibrium in about 20 hr. (Fig. 1). There is little difference in the rate and extent of absorption at 30°c. and 50°c. (Fig. 2), whilst absorption is directly proportional to the molarity of the solution (Fig. 3).

The maximum absorption of monomer from a 4% solution is equivalent to only 2·6% by weight of the wool.

### (*b*) *Polymerisation of Methacrylamide in Wool*

The increases in weight shown by wool treated as described in the experimental section dealing with polymerisation are shown in Table I.

TABLE I

**Weight Increases due to Polymer Deposition**

| Time of Treatment (hr.) | Weight Increase (%) |
|---|---|
| ATMOSPHERIC OXYGEN ABSENT | |
| 1·2 | 28·4 |
| 3·3 | 36·9 |
| 3·4 | 44·3 |
| 18·0 | 61·2 |
| ATMOSPHERIC OXYGEN PRESENT | |
| 1·0 | 1·8 |
| 2·0 | 24·9 |
| 4·0 | 41·5 |
| 4·0 | 42·5 |
| 4·0 | 38·3 |
| 6·0 | 31·9 |

These results show that large amounts of polymer are deposited in the wool after periods of one hour.

The differences between these results and those reported earlier[1] are considered to be due to variations in the quality of monomer. It has been found that polymerisation occurs much more quickly with some samples of methacrylamide than with others, probably owing to the presence of traces of inhibitors in certain batches.

Polymerisation is more rapid in the presence of nitrogen, an increase in weight of 28·4% resulting from 1·2 hr. treatment compared with practically none during a similar time of treatment in the presence of atmospheric oxygen. This is in agreement with the findings of Baxendale, Evans, and Park[4] for polymerisation *in vitro* and of Lipson and Speakman[1] for polymerisation in wool, which show that atmospheric oxygen acts as a chain terminator and inhibits the reaction. For longer times of treatment, there is little difference between results in the presence or absence of atmospheric oxygen.

It will be seen that these increases in weight are considerably greater than the 2·6% which can be accounted for by the maximum absorption of monomer shown above. A possible explanation might be that some polymer may first form in the wool and increase its affinity for monomer owing to an attraction between monomer and polymer. Experiments were therefore carried out to ascertain the absorption of methacrylamide monomer by wool already containing polymer.

### (*c*) *Absorption of Methacrylamide by Wool containing Polymer*

The absorption curves for wool containing 28% of polymer are given in Fig. 4. When these results are compared with those in Fig. 2, it is seen that at 50°c. absorption is faster than for wool not containing polymer, but at 30°c. there is little difference between the rates. The maximum absorption is practically unaltered by the presence of polymer in the wool. The fact that temperature has an appreciable effect on the rate of absorption when

polymer is present in the wool indicates that absorption is activated under these conditions. This is discussed later.

### (d) *Absorption of Methacrylamide by Wool treated with Alcoholic Alkali*

As the rate of absorption of methacrylamide by wool may be controlled by diffusion through the surface layer of fibre, some absorption experiments were undertaken using wool pretreated with alcoholic alkali, which is known to modify the cuticle[5,6].

It is seen, by comparing Fig. 5 with Fig. 2, that treatment with alcoholic alkali increased the rate of absorption of methacrylamide by wool, which is in agreement with Lindberg's results[7] on the absorption of hydrochloric acid. This indicates that the rate of absorption of the monomer is governed by diffusion through the surface layers of the fibre. This is dealt with further in the discussion.

## 4. DISCUSSION

The above results show that methacrylamide is not absorbed to any great extent by wool and that the process is probably one of physical absorption. When polymer is present in the wool, the absorption appears to be activated and the rate increases considerably with temperature. By application of the Langmuir equation[8] the rate constant $k$ of each of the above processes has been calculated as follows—

$$k = \frac{1}{t} \ln \frac{a_e}{a_e - a} \text{ (Langmuir equation*)}$$

$$= \frac{2{\cdot}303}{t} \log \frac{a_e}{a_e - a}$$

where $a$ and $a_e$ are the numbers of moles absorbed in time $t$ and at equilibrium respectively.

From the above equation, if $\log a_e/(a_e - a)$ is plotted against $t$, a straight line of gradient $k/2{\cdot}303$ should result. This has been done for the respective absorptions of methacrylamide by wool and by wool containing polymer as obtained from the earlier graphs. In all cases straight lines were obtained, and from the slopes of these lines the following values for $k$ were found—

| | | |
|---|---|---|
| Wool | | |
| 50°c. | ... | $k_1 = 0{\cdot}127$ |
| 30°c. | ... | $k_2 = 0{\cdot}117$ |
| Wool containing Polymer | | |
| 50°c. | ... | $k_1 = 0{\cdot}501$ |
| 30°c. | ... | $k_2 = 0{\cdot}219$ |
| 20°c. | ... | $k_3 = 0{\cdot}138$ |

The activation energy $E$ of the absorption process may be calculated from the Arrhenius equation—

$$\frac{\mathrm{d} \ln k}{\mathrm{d}T} = \frac{E}{RT^2}$$

where $T$ is the absolute temperature. Integrating between limits $T_1$ and $T_2$—

$$\ln k_1 - \ln k_2 = -\frac{E}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$\log k_1 - \log k_2 = -\frac{E}{2{\cdot}303R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

* Barrer[9] has derived a similar expression for diffusion of dyes into proteins and plastics.

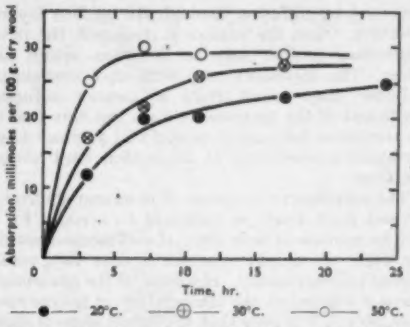



Fig. 4— Absorption of Methacrylamide from a 4% Solution by Wool containing Polymer

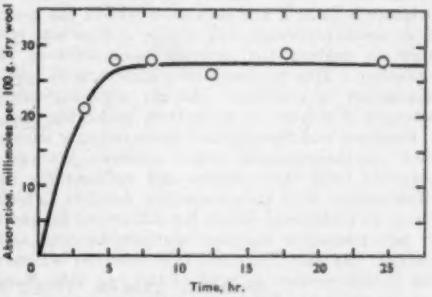



Fig. 5— Absorption of Methacrylamide from a 4% Solution at 50°c. by Wool pretreated with Alcoholic Alkali

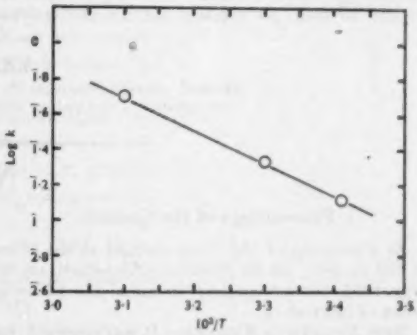



Fig. 6— Effect of Temperature on the Rate Constant of the Absorption of Methacrylamide by Wool containing Polymer

In Fig. 6 $\log k$ has been plotted against $1/T$ for the absorption of 4% methacrylamide by wool containing polymer. From the slope of this line, the activation energy is found to be 8000 g.cal. per mole for wool containing polymer; whilst from the figures for $k_1$ and $k_2$ given above, a value of 800 g. cal./mole can be calculated for wool alone. The former is of the same order as that found by Alexander *et al.*[10] for the dyeing of wool in very dilute solutions.

From the increased rate of absorption shown by wool pretreated with alcoholic alkali, it would seem that the absorption process in normal wool is

governed by diffusion through the surface layers. However, when the surface is damaged, the rate-controlling process may be diffusion within the fibre. The increased rate with wool containing polymer may result from a greater diffusion coefficient of the monomer within the fibre due to an attraction between monomer and polymer or an increased accessibility of absorption sites within the fibre.

The maximum absorption of monomer shown by normal wool would be sufficient to account for a weight increase of only 2·6% if polymerised within the fibre, yet weight increases of over 40% result during polymerisation. However, if the absorption curve is studied at the temperature of polymerisation (50°C.), it is seen that the initial slope is quite steep, particularly where polymer is already present in the wool. It is conceivable, therefore, that as polymer is formed and deposited within the wool, more methacrylamide will rapidly diffuse into the fibre to restore the internal concentration of monomer. This process will continue until polymerisation is complete, thereby enabling large amounts of polymer to be built up within the fibre.

Fearnley and Speakman[11] have recently shown that methacrylamide can remove hydrogen peroxide from the solution and so diminish its effectiveness as a polymerisation catalyst, which forms an additional reason for differences in speed of polymerisation between methacrylic acid and methacrylamide. The differences observed between the polymerisation in wool of the two monomers are also related to differences in the amounts of each monomer that can be absorbed by the wool. With methacrylic acid, enough monomer is absorbed within 10 min. to account for all the polymer formed, whereas with methacrylamide, the process outlined above probably occurs.

* * *

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### References

[1] Lipson and Speakman, J.S.D.C., **65**, 395 (1949).
[2] Lucas and Pressman, *Ind. Eng. Chem.* (*Anal. Ed.*), **10**, 140 (1938).
[3] Blout, Hohenstein, and Mark, *Monomers* (New York and London: Interscience Publishers 1949), section on Methyl Methacrylate, p. 9.
[4] Baxendale, Evans, and Park, *Trans. Faraday Soc.*, **42**, 155 (1946).
[5] Royer, Millson, and Amick, J.S.D.C., **63**, 214 (1947).
[6] Lindberg, Mercer, Philip, and Gralén, *Text. Research J.*, **19**, 673 (1949).
[7] Lindberg, *ibid.*, **20**, 381 (1950).
[8] Langmuir, *J. Amer. Chem. Soc.*, **40**, 1361 (1918).
[9] Barrer, *Fibrous Proteins* (Bradford: the Society 1946), p. 108.
[10] Alexander, Gough, and Hudson, *Trans. Faraday Soc.*, **45**, 1058 (1949).
[11] Fearnley and Speakman, J.S.D.C., **66**, 374 (July 1950).

## ERRATUM

**Driers.** Nuodex Products Co. Inc. (J.S.D.C., **67**, 157 (April 1951))—
The number of the patent should be *B.P.* **648,835**, not "648,638".

# Notes

### Proceedings of the Council

At a meeting of the Council, held at the offices of the Society, 32–34 Piccadilly, Bradford, on 9th May 1951, the proceedings included the following items of interest—

NEW *EX-OFFICIO* MEMBER— It was reported that Mr. A. P. Kershaw had recently become an *ex-officio* member of the Council as Chairman of the Midlands Section.

COMMITTEE MEMBERSHIP— The review was continued of the membership of committees of the Society (see p. 254).

REPRESENTATION ON EXTERNAL BODIES— The review was continued of the representation of the Society on external bodies (see p. 255). The resignation of Mr. F. Scholefield as the Society's representative on the Cotton Industry Committee of the British Standards Institution was accepted with regret.

BOURNEMOUTH I.S.O. MEETING— On the recommendation of the Fastness Tests Co-ordinating Committee, Mr. J. Barritt was nominated as Chairman for the session on colour fastness.

JUNIOR MEMBERSHIP— It was decided to draw the attention of Sections to the importance of encouraging junior membership of the Society.

MEMBERSHIP— Thirteen applications for ordinary membership were approved.

### Meetings of Council and Committees
### June

Council— 13th
Publications— 19th
*Colour Index* Editorial Panel— 4th
Fastness Tests Co-ordinating— 29th

### Annual Meeting of Chairmen and Honorary Secretaries of Sections 1951

This meeting was held at the Grand Hotel, Leicester, on 31st March 1951, under the chairmanship of Mr. H. Jennison (Honorary Treasurer of

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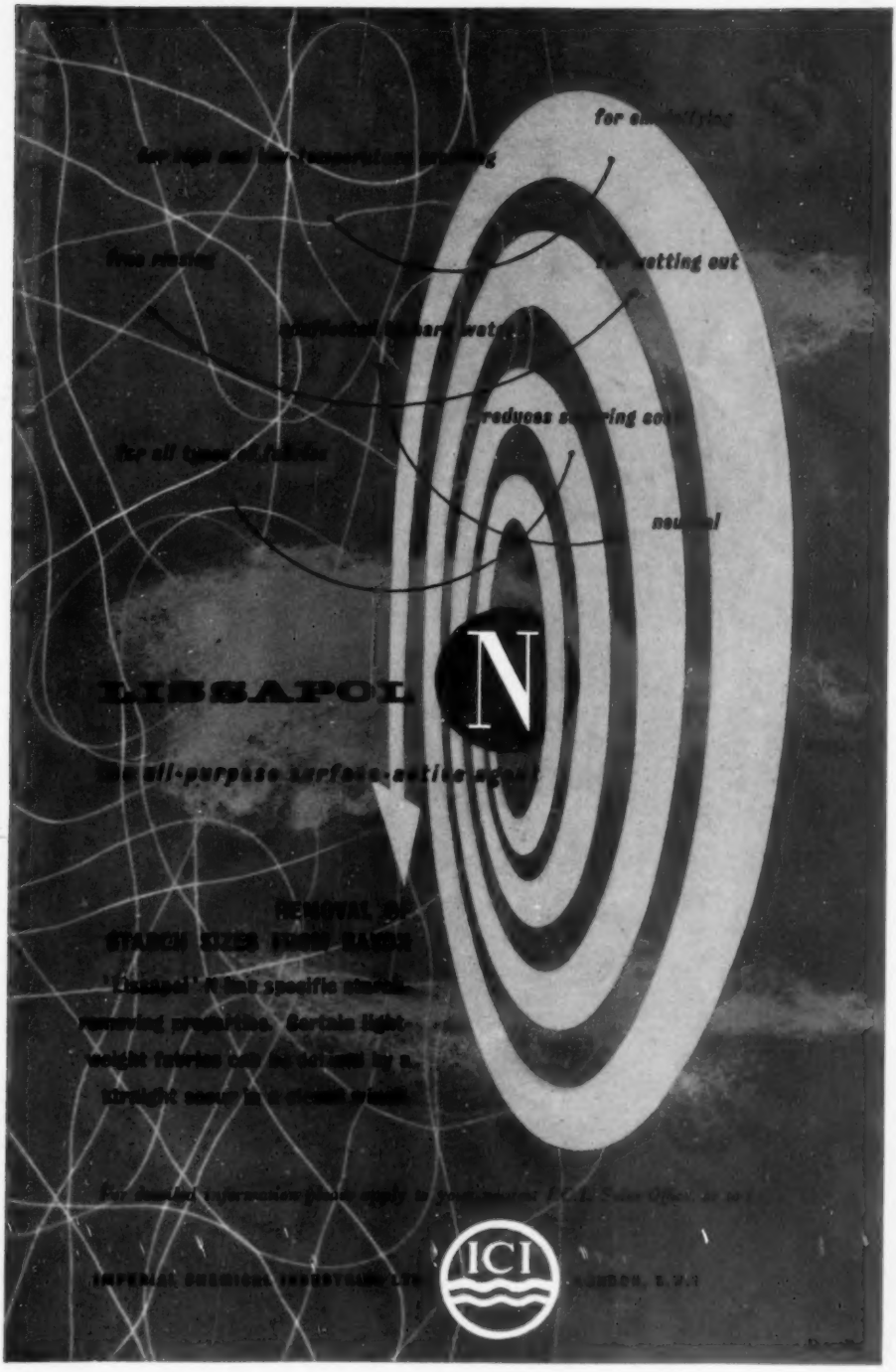
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*Publication Number*

102/1 Machining of Corrosion and Heat-Resisting Steels.
103 Manipulating of Corrosion and Heat-Resisting Steels.
104 Creep-Resisting Steels for Gas Turbines.
105/1 Corrosion Resisting Chart.
106/1 Types of Steel and Forms in which supplied.
108/3 Mechanical and Physical Properties of Staybrite and Stainless Steels.
109/1 Mechanical and Physical Properties of Heat-Resisting Steels.
110/1 Composition of Firth-Vickers Steels and Corresponding American I. S. I. Types.
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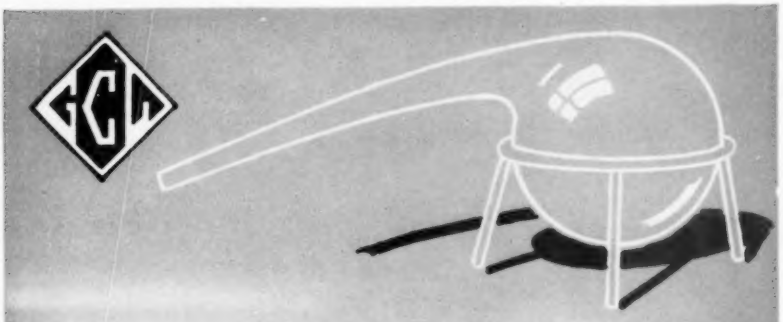

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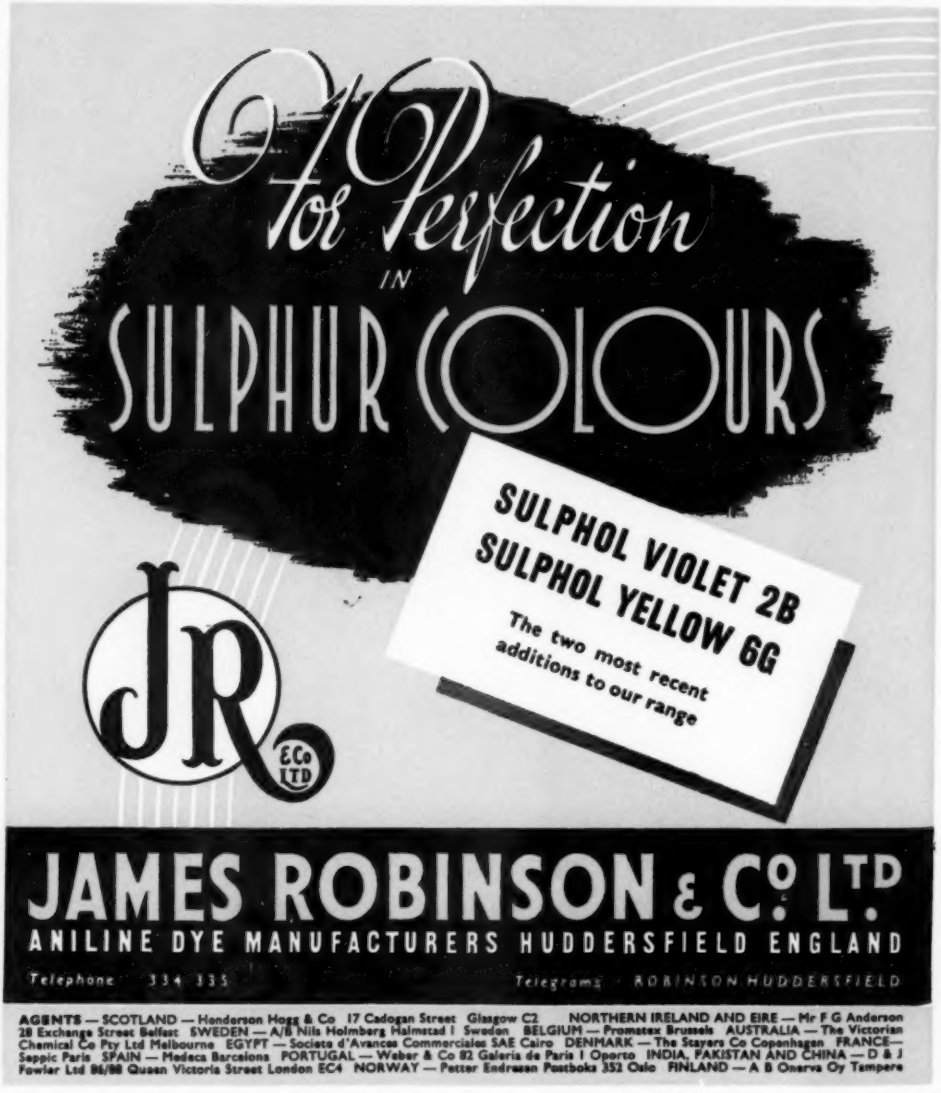


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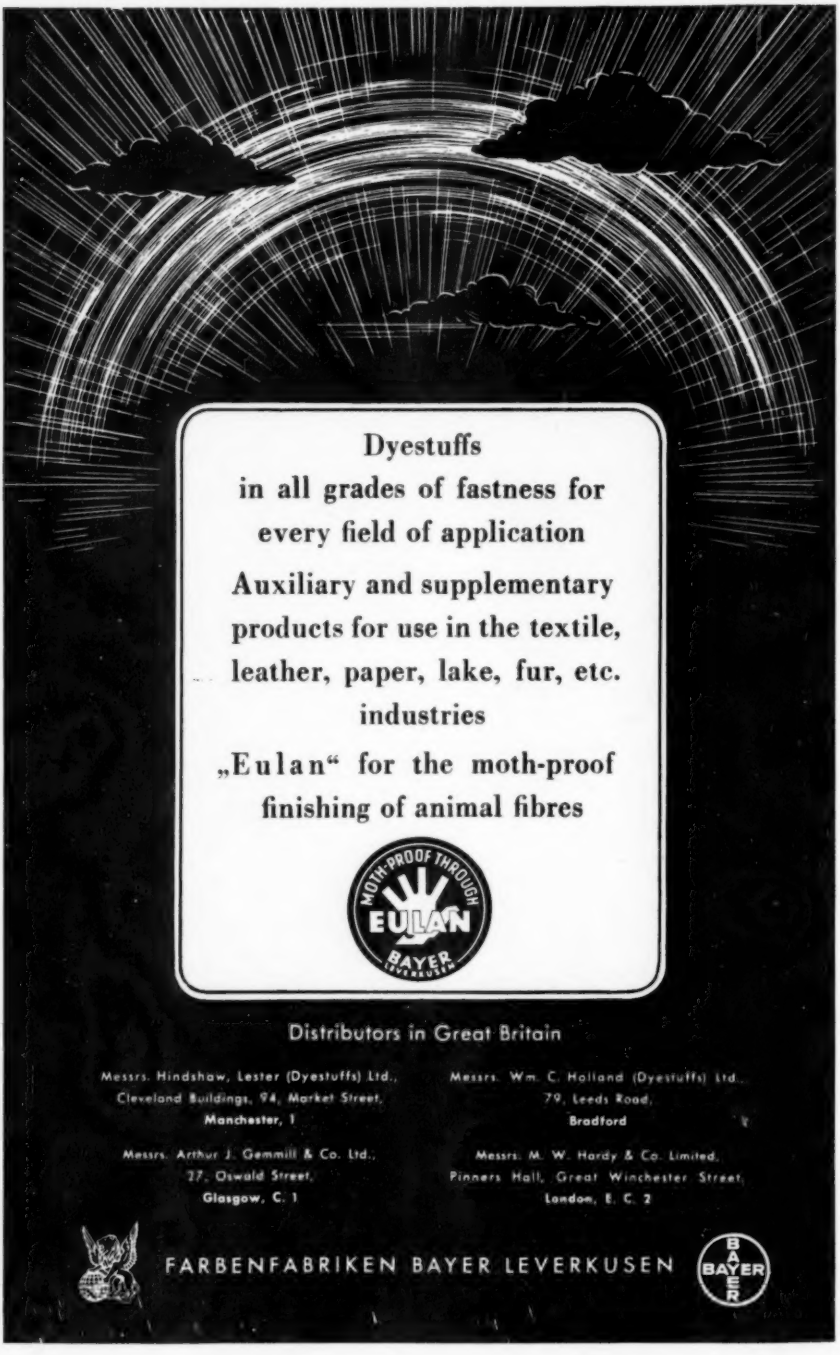
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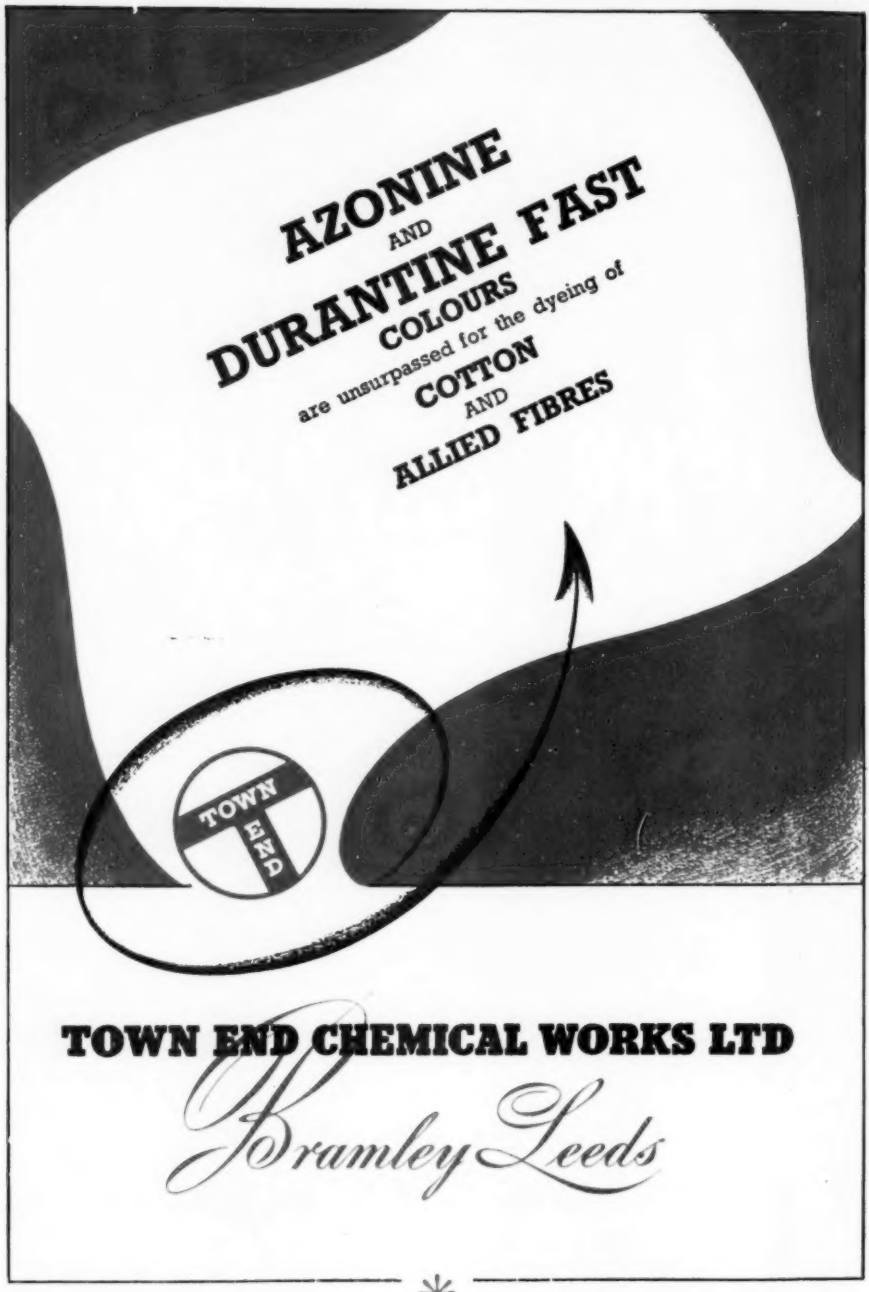
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the Society). Topics which were discussed included suggested subjects for lectures in the 1951–52 session, membership, and the publication of practical papers in the *Journal*. Consideration was given also to the status of Vice-presidents and recommendations were approved for submission to Council.

## Reports of Sections for the Session 1950–1951

### HUDDERSFIELD SECTION

The 31st Annual Report of this Section again records a very successful session. We have tried to cater for the specific requirements of the members of this Section by again arranging for both academic and practical lectures to be given.

The session has been a very active one for this section. No less than eleven meetings have been arranged, which include one as a joint meeting with the West Riding Section and the Halifax Textile Society, and, as in previous years, a joint meeting with the Huddersfield Textile Society, and the Huddersfield Section of the Royal Institute of Chemistry.

We held our Annual Dinner on 31st October 1950, which was very successful and enjoyable.

Three of our members took an active part in the Summer School on Dyeing at Leeds University in September.

During the past twelve months, we have also paid three visits—

Courtaulds Ltd., Droylsden
L. B. Holliday & Co. Ltd., Huddersfield
Standfast Dyers & Printers Ltd., Lancaster

These visits were extremely interesting and instructive, and we are very grateful to the firms concerned for making them possible.

In conclusion, I should again like to thank all the Officers and Members of Committee, without whose splendid help we could not have reported such a successful session.

H. TURNER
*Honorary Secretary, Huddersfield Section*

### MANCHESTER SECTION

Nine meetings have been held in Manchester during the Session, the average attendance being slightly below that of last session. The Section was honoured by the presence of two of the Society's medallists for the April meeting, when the opportunity was taken to present the Gold Medal of the Society to P. W. Cunliffe, Ph.D., F.R.I.C., F.T.I., and a Bar to the Silver Medal of the Society to L. A. Lantz, Ing. Chim. An external meeting took place in Leek, jointly with the Leek Textile Society, and the Junior Branch continued its independent existence and held four meetings. Details of the lectures and attendances are as follows—

MANCHESTER

15th September 1950 74
*The Dyeing of Acetate Rayon with Vat, Acid, and Direct Colours*
R. F. York

13th October 1950 102
*The Swelling of Fibres*
W. W. Barkas

17th November 1950 (Ladies' evening) 80
*Why this Fabric!*
R. Meredith, A. M. Latham, H. A. Thomas, and Mrs. A. S. Fern

8th December 1950 64
*Further Observations on the Behaviour of Dyes in the Steaming Process of Textile Printing*
H. A. Turner

19th January 1951 93
*Continuous Fixation Processes for Water-soluble Dyestuffs*
G. T. Douglas

16th February 1951 72
(a) *The Physical Measurement of Dyeings, with special reference to the Ellis Photometer*
H. W. Ellis
(b) *Discussion on the Physical Society Report on Colour Terminology*
T. Vickerstaff

16th March 1951 101
*Some Aspects of the Crease-resist Process*
H. W. Best-Gordon

29th March 1951 (Joint meeting with the Textile Institute, Lancashire Section) 95
*Applications of Quantitative X-Ray Methods in the Investigation of the Degree of Crystallinity of Cellulose Fibres*
P. H. Hermans

13th April 1951 (Annual General Meeting) 95
*Trends in Training for Technology*
F. Scholefield

LEEK

7th February 1951 (Joint meeting with Leek Textile Society) 30
*The Principles of Dyeing*
T. Vickerstaff

Junior Branch

7th November 1950 33
*The Development of a New Dyestuff*
H. B. Bradley

5th December 1950 31
*Some Problems of a Dyehouse Manager*
J. J. Barker

30th January 1951 70
*The Application of Metallisable Dyestuffs*
F. W. Bradley

3rd April 1951 65
*Detection and Correction of Faults in Dyed Materials*
S. R. Cockett

It is a pleasure to express our gratitude to those who have contributed to these meetings, and to Mr. F. Scholefield, the Manchester College of Technology, and the North-Western Gas Board (Manchester Undertaking) for accommodation.

Seven committee meetings were held during the Session. Apart from arranging lectures, the Committee has submitted to Council a series of proposed amendments to the Bye-laws concerning Vice-presidents. Other Sections have been requested to do likewise, and a meeting of sectional representatives has been held to discuss the matter thoroughly.

Mr. Preston has continued to represent the Section on the Post-advanced Chemistry Advisory Committee of the Manchester and District Advisory Council for Further Education. The Section has been represented on the Committee of the Manchester Federation of Scientific Societies by the Chairman and Honorary Secretary.

A formal dance was organised at the Grand Hotel, Manchester, on 17th February 1951. Approximately 120 members and guests were present, and the evening was generally regarded as highly successful Our thanks are due to the sub-committee responsible, which consisted of Dr. H. A. Thomas, Mr. F. Crompton, Mr. E. Rhodes, and Mr. H. R. Hadfield.

It was a pleasure to welcome Dr. C. J. W. Hooper (Editor and General Secretary of the Society) and his wife to our Ladies' Evening on 17th November 1950.

The Knecht Memorial prize was won by Mr. L. B. Hallows, who was a student in the third year Higher University Course in Textile Chemistry at the Manchester College of Technology.

We acknowledge the gift of copies of the first two volumes of the Society's Journal, by the Leek Textile Society. These have been offered to Council as being of historical interest.

We offer our congratulations to Mr. R. J. Hannay on his appointment as Technical Development Manager, Messrs. Brotherton & Co. Ltd. He has been a member of committee for thirteen years, then Vice-chairman, and finally Chairman since

1949. His experience, enthusiasm, and conscientious attendance at meetings have been invaluable to the Section, and his services will be greatly missed. We wish him success and happiness in his new position. Mr. Hannay will be succeeded as Chairman by Mr. F. Farrington, and Mr. G. S. J. White has been elected Vice-chairman for 1951–52.

The membership of the Section continued to increase, and is now over 600. The number of Junior members has, however, decreased slightly—

| | 1950 (April 21st) | 1951 (April 13th) |
|---|---|---|
| Members ... | 560 | 585 |
| Juniors ... ... | 26 | 25 |
| | 586 | 610 |

We regret to record the death of two members of the Section who rendered valuable services for many years— Mr. L. Thompson, Honorary Secretary, Member of Committee, Vice-chairman and Chairman of the Section, and Mr. E. B. Adam, a Member of the Committee.

A. S. Fern

*Honorary Secretary, Manchester Section*

### MIDLANDS SECTION

Among the Sections of our Society, the Midlands is unique in that, to cater for a scattered membership, it moves the venue of its meetings around the various localities. We are fortunate to have so many members in that loyal band who make a point of being present at every meeting, wherever held. The result is that our average attendance has been well maintained, though appalling travelling conditions limited our numbers on two occasions. Ten lecture meetings have been held, three in Loughborough, two each in Leicester and Nottingham, one at Nuneaton, and a joint meeting with the British Association of Chemists at Derby; while in May members were the guests of the Textile Institute at a joint meeting in Kidderminster.

After sharing for five years, with other sections, a notable increase in membership, the Midlands Section now shows the same trend as the Society in general, viz. a comparatively small increase over the past session. The figures are—

| | |
|---|---|
| New members ... ... ... | 18 |
| Resignations ... ... ... | 9 |
| Transfers from other Sections ... | 10 |
| Transfers to other Sections ... | 15 |
| Net gain ... ... ... ... | 4 |

Many of the resignations were from older members retiring from active work. A drive to replace them by young men entering our profession is indicated.

On the social side, our Section Dinner in February was the usual happy function. An innovation was a Ladies' Social Evening in October 1950, the success of which makes it probable that we shall repeat the project in a more ambitious form. Leicester was proud to be "at home" to the Annual General Meeting and Dinner of the Society in March, the success of which is fully reported in this issue.

Once more the Section would like to pay tribute to those members of our Society who (all too often unhonoured and unsung) devote no inconsiderable time to attendance on, and work on behalf of, the various standing committees of the Society. Our Section is well represented in the list published annually in the *Journal*; the other serving members of the Midlands Section will, we are sure, forgive us if we single out the name of Mr. H. C. Olpin. The senior member of our committee, he has this year been honoured by election to Council. Mr. W. A. Edwards, after the stipulated stand-down period, resumes his lengthy term as a Vice-president of the Society. Our thanks are due to Mr. F. M. Stevenson (Vice-president) and Mr. W. Penn (Ordinary Member of Council) for their services over the last three years. They now retire under rule.

After two happy years in the Chair of the Section, Mr. W. L. Langton retires in favour of a long-serving member of the Committee, Mr. Alan P. Kershaw. At the Annual General Meeting of the Section, Messrs. S. R. Meadows, C. Schardt, G. L. Thornton, R. Fernsby, and J. V. A. Haywood were re-elected to the Committee, while the undersigned was once more appointed Honorary Secretary.

A. W. Carpenter

*Honorary Secretary, Midlands Section*

### SCOTTISH SECTION

The year under review has again been very happy and successful. During the session nine meetings were arranged, as follows—

| | | |
|---|---|---|
| (1) | *The Physical Measurement of Dyeings with special reference to the Ellis Photometer* ... | H. W. Ellis |
| (2) | *A Study of the Metachrome Dyebath* ... ... | G. H. Lister |
| (3) | *pH Control and Practical Wool Dyeing* ... ... | G. H. Lister |
| (4) | *Fast Shades on Nylon* ... ... ... ... | G. T. Douglas |
| (5) | *Aspects of the New Petroleum Chemical Industry in the United Kingdom with special reference to the Textile Industry* ... ... ... ... | J. M. Butler |
| (6) | *Some Recent Developments in Dispersed Azo Dyes for Acetate Rayon and Nylon* | E. Stead and A. Murray |
| (7) | *Causes of Unlevel Dyeing of Cotton Threads (The Effect of Differences in the Cotton Substrate)* | I. Gailey |
| (8) | *Developments in Continuous Dyeing* ... | ...G. L. Boardman |
| (9) | *The Performance and Efficiency of Drying Machines* ... ... ... ... ... | K. S. Laurie |

Lectures 3 and 8 were held in Galashiels and Dundee respectively, when local members of the Textile Institute were invited. New ground was broken in holding a meeting in Dundee, and the support received was very encouraging. In addition to the above, the Textile Institute invited our members to a meeting which they had arranged in Galashiels, when Dr. P. W. Cunliffe gave a lecture on "Package Dyeing".

Attendances throughout the session have been exceptionally good.

At the conclusion of the session the Eighth Mercer Lecture was held in Glasgow, and it is particularly gratifying to record that the lecturer on this occasion, Dr. D. Traill, is one of our own Sectional members. On the afternoon preceding the Mercer Lecture, a visit was arranged to Messrs. J. & P. Coats' Anchor Mills, Paisley, and we are indebted to the Management and Staff of this Organisation for a very interesting and enjoyable afternoon.

Mr. D. B. F. McAndrew and Mr. R. D. Alexander continue in office, as Chairman and Vice-chairman respectively, for a further period.

F. Atack

*Honorary Secretary, Scottish Section*

WEST RIDING SECTION

Under the Chairmanship of Mr. E. A. Swift the Section has continued to prosper and its membership to increase.

Eight lectures have been held in Bradford, all of which have been well attended (average 100), one in Leeds, and a joint lecture with the Halifax Textile Society in Halifax.

The "Smoker" and the Ladies' Evening were again most successful and enjoyable, both being attended to about the capacity of the room.

The Committee have met on five occasions, the average attendance of elected members being thirteen.

The Junior Branches are to be commended on their activities. The "Prize Scheme" inaugurated last session has produced four papers on widely varying subjects and appears to have achieved its object in stimulating our younger members.

Harold Foster

*Honorary Secretary, West Riding Section*

NORTHERN IRELAND SECTION

The 1950–51 session has been quietly successful, particularly from the point of view of lectures. Seven lectures were given during the session, and as these were mainly of a practical nature, we are pleased to report good attendances.

Membership has shown a slight increase, and this we regard as satisfactory considering the limited potential of this area.

At the Annual General Meeting held on 19th March 1951, Mr. D. A. Derrett-Smith was elected Chairman and Mr. J. Montgomery Vice-chairman. We take this opportunity to express our best thanks to Mr. J. H. Jackson for his excellent services as Chairman during the past two years.

Our Annual Dinner was held on 7th April 1951, when we had the pleasure of entertaining our President, Mr F. Scholefield, and the Minister of Commerce for Northern Ireland, The Right Honourable W. V. M'Cleery, J.P., M.P. An excellent musical programme was given by well known local artistes, and we regarded this as the most successful social function we have had so far.

We now look forward to a successful 1951–52 session.

James Porter

*Honorary Secretary, Northern Ireland Section*

# Abstracts from British and Foreign Journals and Patents

*(The Titles of Patents are abridged and modified)*

## I—PLANT; MACHINERY; BUILDINGS

**Investigation of Different Sheet Metals for Washing Machines, and their Corrosion Resistance in Continuous Washing Practice.** O. Viertel and G. Schikorr. *Melliand Textilber.*, **31**, 852–854 (Dec. 1950).

During the last war the use of copper for the inner rotating cages of washing machines was forbidden. Continuous washing trials were made in a machine adapted to carry test-pieces of various metals. Three different washing methods were employed under standardised conditions. The weight losses of the materials and their general appearance after as many as 900 washes showed stainless steel to be the most suitable metal. There was considerable attack on the zinc and zinc–copper alloy, and the attack on galvanised steel and copper-plated steel was so great as to make their use impracticable. H. K.

PATENTS

**Carbon Black.** Columbian Carbon Co. and G. L. Heller. *U.S.P.* 2,529,873.

Apparatus for making furnace blacks is described. C. O. C.

**Treating Textile Fibres in Cakes.** B. Steverlynck. *B.P.* 652,293.

The cake is placed in a tubular carrier made from a plate of thin perforated non-oxidisable material rolled so that one edge overlaps the other, thus imparting transverse elasticity to the carrier. The cake is thus held in such a manner that the treating liquors are uniformly and regularly distributed throughout the cake without in any way entangling the yarn, so that after drying the yarn may be unwound quite normally. The carriers are so formed that they can form a column by fitting into one another. C. O. C.

**Controlled Impregnation of Textiles.** Dayton Rubber Co. *B.P.* 651,207.

The material passes between two squeeze rollers, the lower one of which dips into the impregnating liquor. The upper roller has an inner bulk layer of solid rubber and an outer layer of sponge rubber with channels interconnecting a number of pores. A high degree of accuracy of take-up of the liquor by the textile is obtained, the sponge rubber portion of the upper roller either absorbing surplus liquor or adding extra liquor to the textile as necessary. C. O. C.

**Liquor Circulation.** Freeman, Taylor Machines Ltd. and S. R. T. Freeman. *B.P.* 651,580.

The level of liquor in a tank or vat is raised and lowered by a force in balance with the liquor so as to effect static displacement of the latter; e.g. steam at 30 lb./sq. in. pressure is brought to bear on the liquor so as to raise its level, controlled reduction or release of the steam pressure at chosen times allowing the liquor to return to its normal, i.e. low, level. This enables the liquor to be circulated through goods under treatment without any violent disturbance of the liquor. C. O. C.

**Wetting the Upper Surface of Moving Webs of Paper or the like.** Societa Anonima Italiana Kores. *B.P.* 650,941.

A device for wetting the upper surface of a moving web of paper, etc. comprises a porous spreader (e.g. of felt) supplied with liquid from a closed vessel (e.g. a horizontal tube fitted with a spring-loaded air valve) at a higher level than the web, the outlet(s) from the vessel being closed by the felt band and the inlet(s) being connected by means of conduits at each end with an open reservoir placed below the level of the web, the vessel being kept full by the excess of atmospheric pressure on the liquid in the reservoir over the atmospheric pressure through the porous material on

the outlet(s) from the vessel, and the rate of feed of the liquid being influenced by the adjustable difference in level between the vessel and the reservoir, which has an open-topped filling tube fitted to one of its two compartments. S. V. S.

**Calenders for Coating Rubber or Adhesive on to Cloth, Paper, Metal Foil, Cellulose, or Synthetic Resin Films, etc.** Firestone Tyre & Rubber Co. Ltd. and J. B. Collins. *B.P.* 652,244.

An arrangement is described whereby discontinuity in the film or layer of coating material being applied influences an electric circuit so as to stop the calender working. C. O. C.

**Drying Web.** B. Offen. *U.S.P.* 2,532,032.

The material is dried by being heated in several stages by radiant heat and hot air. On the machine being stopped the hot air is cut off, the sources of radiant heat move away from the material, and cold air is blown into the chamber, all three occurring automatically and simultaneously. This enables the machine to be brought to a sudden stop without risk of scorching the material being dried. C. O. C.

**Tentering Machine.** J. Dungler. *U.S.P.* 2,530,119.

A tentering machine has a stationary guide member and clips to engage the selvedges of the fabric. Each clip has traction-absorbing means and weight-carrying means, both of which support it on the guide. There are a number of drive means for displacing the gripping devices. The traction-absorbing and weight-carrying means of each clip are both disposed at the same side of a vertical plane passing through the centre of gravity of the combination of each clip and its drive means, this plane extending in the direction of the displacement of the clip. This enables the clip to operate with minimum friction, ensures correct guidance at all times, and permits flexibility and automatic adjustability with respect to the fabric being tentered. C. O. C.

**Inspection and Cleaning Tables for Textiles.** D. O. Wylie. *U.S.P.* 2,530,038.

The textiles are fed over an inspection table which has a perforated section having a collector pan beneath it. While the textile is over the perforated section it is impregnated with cleaning fluid, and while there the cleaning fluid and any foreign material in the textile are blown by air or steam into the collector pan. C. O. C.

**Safety Mechanism for Preboarding Machines.** Proctor & Schwartz Inc. *B.P.* 652,009.

**Plasticising Nylon Hose.** British Schuster Co. Ltd. and L. Heldmaier. *B.P.* 651,704.

Nylon hose placed on forms carried by an endless conveyor are plasticised by passing through a chamber, where they are subjected to steam and infra-red radiation. Immediately before the plasticising chamber is a separate chamber in which hot air or steam is circulated, providing a controlled preheating of forms and hose. G. E. K.

**Laundry Machine incorporating Damp Drying Features through Centrifugal Extraction of Moisture.** L. M. Kahn. *U.S.P.* 2,528,594.

**Automatic Laundry Washing Machine.** American Machine & Metals Inc. and G. G. Gaubatz. *U.S.P.* 2,529,334.

Garments do not become tangled as long is there is detergent in the bath. Thus the drum needs only uni-directional rotation during sudsing, but the rotation of the cylinder is reversed after every few revolutions when using a bath not containing detergent, e.g. when rinsing. Apparatus which operates automatically in this manner is described. C. O. C.

**Superheated-steam Garment Finisher.** E. C. Maurer. *U.S.P.* 2,530,067.

An extremely simple and inexpensive unit is described in which superheated steam may be directed on to a garment supported by the unit. C. O. C.

**Emulsifying Apparatus.** International Morfat Corpn. Ltd., C. O. Rasmüssen, and H. S. Brochner. *B.P.* 652,011.

A liquid phase is emulsified under pressure into another liquid phase, or a thin disperse phase is increased in amount, in a spherical emulsification chamber traversed by the continuous phase. In the lower part of the apparatus is an atomiser with a large number of small jets, through which the continuous phase is injected upwards, the particles colliding with those of the disperse phase, which are injected downwards through a similar atomiser opposite. J. W. B.

## III—CHEMICALS; AUXILIARY PRODUCTS; FINISHING MATERIALS

**Method of Synthesising Esters of Orthosilicic Acid.** M. G. Voronkov and B. N. Dolgov. *J. Appl. Chem. (U.S.S.R.)*, **24**, 93–94 (Jan. 1951).

To obtain a good yield in the preparation of an orthosilicic ester from silicon tetrachloride and an alcohol, the alcohol must be anhydrous, and the formation of water by the interaction of alcohol and HCl must be minimised. Hitherto the precautions taken to achieve the necessary conditions have included the use of an absolute alcohol, carrying out the reaction at $-80°$c., adding the $SiCl_4$ to the alcohol very slowly, and displacing the HCl, as formed, by a stream of inert gas. A much more convenient method is now described—To the alcohol, which need not be anhydrous, a little $SiCl_4$ is added, and the mixture is distilled to yield anhydrous alcohol containing HCl. This is boiled under reflux, and rather less than the equivalent amount of $SiCl_4$ is added as rapidly as possible with vigorous stirring. Under these conditions the concn. of HCl remains low. When reaction is complete the mixture is fractionated. Good yields are obtained (e.g. $> 80\%$ for the methyl ester; the best yield by the old method was $< 70\%$). A. E. S.

**Influence of Ordinary Electrolytes on Micelle Formation in Colloidal Electrolyte Solutions.** H. Lange. *Kolloid-Z.*, **121**, 66–71 (Feb. 1951).

Critical concentrations $C_c$ have been measured by the dye method at 70°c. for micelle formation of sodium dodecyl sulphate with additions of NaCl, KCl, $MgCl_2$, $CaCl_2$, and $AlCl_3$, and also of calcium dodecyl sulphate with NaCl and $CaCl_2$ at different salt concentrations. Measurements of $C_c$ have also been carried out for dodecylpyridinium chloride at 50°c. with additions of NaCl, NaBr, NaI, $NaNO_3$, KSCN, $Na_2SO_4$, and $Na_4P_2O_7$. It is found that multivalent cations lower the $C_c$ of Na dodecyl sulphate much more than univalent. This phenomenon is analogous to the Schulze–Hardy valency rule in the electrolytic flocculation of hydrophobic sols. The valency effect diminishes, however, with increasing salt concentration. The changes in $C_c$ of Na and of Ca dodecyl sulphates (anion-active substances) by additions of salts with uni- or bi-valent cations are also in agreement with the mass action law. In the case of the cation-active dodecylpyridinium chloride, the lowering of the $C_c$ corresponds to the flocculation of hydrophilic sols according to the Hofmeister anionic series. There are 7 references. H. H. H.

PATENTS

**Size for Yarns.** Celanese Corpn. of America and C. C. Abramson. *U.S.P.* 2,528,570.

An excellent size for yarns of regenerated cellulose consists of an aqueous composition containing casein, an alkylolamine, oleic acid, a defoaming agent, and a preservative. C. O. C.

**Plasticised Hydrophilic Colloids.** E. F. Drew & Co. Inc. and H. A. Molteni. *U.S.P.* 2,530,439.

Free fatty acids containing $> 5$ C chlorinated with at least 2 atoms of chlorine are plasticisers for protein and carbohydrate colloids, e.g. for zein or starch pastes for coating paper. C. O. C.

**Antioxidants.** I.C.I. Ltd., J. Haworth, and A. Lambert. *B.P.* 651,368.

Bis(hydroxydimethylphenyl)alkanes useful as antioxidants, particularly in making vulcanised rubber, are obtained by heating 50–80% of 2:4-dimethylphenol and 50–20% of 2:5-dimethylphenol with an aliphatic aldehyde of 8–12 C in presence of an acid condensing agent. *B.P.* 651,369.

1:1-Bis(2′-hydroxy-3′:5′-dialkylphenyl)nonanes having similar or better antioxidant properties to the above compounds are obtained by heating a nonaldehyde with a 2:4-dialkylphenol (alkyl groups of $<3$C) in presence of an acid condensing agent. C. O. C.

**Adhesive Composition containing Glycidyl Ethers and Alumina.** Shell Development Co. and Q. T. Wiles. *U.S.P.* 2,528,933.

Glycidyl ethers of polyhydric phenols form resins when a hardening agent is added. These resins are excellent adhesives. Incorporation of powdered alumina with the glycidyl ether gives a cured adhesive of much greater strength than in absence of alumina. C. O. C.

**Adhesive Composition containing a Fluidised Glycidyl Ether and an Amphoteric Oxide.** Shell Development Co. and Q. T. Wiles. *U.S.P.* 2,528,934.

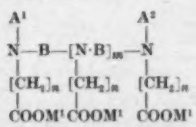
Incorporating a fluidising amount of a normally liquid, non-volatile monoepoxy compound into a mixture of a solid glycidyl ether of a polyhydric phenol and a powdered amphoteric oxide yields a spreadably fluid composition which, upon addition of a hardening agent, cures without heating, to yield a hard material of great physical and adhesive strength which is also very resistant to heat and water. C. O. C.

**Non-foaming Dispersing Agents.** United States Rubber Co. *B.P.* 652,128.

The water-soluble polymeric ester of 2-ethyl-1:3-hexanediol and sulphosuccinic acid obtained by heating the half ester of 2-ethyl-1:3-hexanediol and maleic acid so as to form a maleic alkyd resin of acid value 40–50 and then treating with an alkali bisulphite is a non-foaming dispersing agent which imparts no discoloration on ageing to white, colourless, or slightly coloured synthetic resins. C. O. C.

**Alkylenepolyamine Derivatives having Detergent, Wetting, and Metal-ion-sequestering Properties.** F. C. Bersworth. *U.S.P.* 2,530,147.

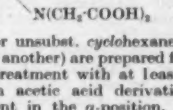
Compounds of formula—



($A^1$ and $A^2$ = hydrocarbon radicals together containing > 9 C and having < 3 of their H atoms replaced by –COOH, –COOR, or –$COOM^3$; R = the radical of an alcohol ROH; $M^3$ = an alkali metal; B = ethylene or propylene; $n$ = 1 or 2; $m$ = 0 or a whole number; $M^1$ = H or an alkali metal) are detergents and wetting agents compatible with soap and possessing metal-ion-sequestering properties. C. O. C.

**Tetrakiscarboxymethyl - 1:2 - diaminocyclohexanes for Dispersing Lime Soaps.** J. R. Geigy S.A. *B.P.* 651,990.

Compounds of formula—



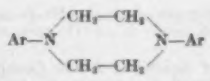
(A = Alk-subst. or unsubst. *cyclo*hexane nucleus with N atoms *ortho* to one another) are prepared from *cyclo*hexane-1:2-diamines by treatment with at least four molecular proportions of an acetic acid derivative containing a reactive substituent in the $\alpha$-position, e.g. chloroacetic acid. Alkali-metal salts of the product are water-soluble and useful for forming complexes with heavy metal ions in solution and for redissolving lime precipitates already formed, thus serving as dyeing and washing assistants. J. W. B.

**Gas-fading Inhibition using *N*-Benzylated Aminotriazoles and -tetrazoles.** General Aniline & Film Corpn., H. W. Grimmel, and J. F. Morgan. *U.S.P.* 2,529,016.

The water-insoluble colourless *N*-benzylated derivatives of 3-amino-1:2:4-triazole and 5-aminotetrazole are gas-fading inhibitors suitable for application in the dyebath. C. O. C.

**1:4 - Diarylpiperazines as Gas-fading Inhibitors.** General Aniline & Film Corpn., H. W. Grimmel, and A. Guenther. *U.S.P.* 2,529,935.

Compounds of formula—



(Ar may contain Alk, Alk·O, Hal, and CN substituents) are excellent gas-fading inhibitors suitable for application in cellulose acetate dyebaths. C. O. C.

**Foam Inhibitors.** Ciba Ltd. *B.P.* 651,307.

Compounds of formula $HSiR^1R^2R^3$ or $SiR^1R^2R^3R^4$ ($R^1$, $R^2$, $R^3$, and $R^4$ = same or different Alk each of 2–6 C), e.g. triethylsilane, are excellent foam inhibitors for use in textile processing liquors, printing pastes, viscose spinning solutions, and the paper industry. C. O. C.

**Tetrachloroethyl Ethers of Phenols and their Derivatives—Insecticides.** Ciba Ltd. *B.P.* 651,652.

Compounds of formula $R(O{\cdot}CHCl{\cdot}CCl_3)_n$ (R = a benzene residue either unsubst. or having one or more substituents not affected by chlorine in the cold; $n$ = 1 or 2) are stable, high boiling, and of good insecticidal value. They may be used for protecting furs, feathers, and wool from attack by pests. C. O. C.

**Emulsions of Copolymers of Methyl Methacrylate.** Vinyl Products Ltd. and H. Warson. *B.P.* 651,420.

Aqueous emulsions of methyl methacrylate–styrene copolymers, preferably having equimolecular proportions of each constituent, and a non-polar plasticiser are good finishing agents for leather and textiles. C. O. C.

**Thixotropic Emulsions containing Resins, Oils, or other Water-insoluble Substances.** Sharp & Dohme Inc. and H. J. Schneiderwirth. *U.S.P.* 2,529,460, *U.S.P.* 2,529,461.

Thixotropic emulsions are obtained by mixing an aqueous dispersion of a water-insoluble alkaline-earth metal salt with a water-immiscible or -insoluble substance in presence of a citrate. C. O. C.

**Moistureproofing Composition.** Monsanto Chemical Co. and J. E. Moose. *B.P.* 651,716.

A hot-dip coating and impregnating composition for paper, textiles, etc. consists of a mixture of a natural or synthetic wax, a terphenyl, and a hydrogenated terphenyl or *N*-diphenylylstearamide. C. O. C.

**Textiles made Rotproof with Bis - 4 - hydroxy - 3 - chlorophenyldimethylmethane.** B. F. Goodrich Co., W. D. Stewart, and J. H. Standen. *U.S.P.* 2,530,792.

Deposition of 0·25–1·0% by weight of bis-4-hydroxy-3-chlorophenyldimethylmethane on cotton renders it rotproof. C. O. C.

**Polymerising Non-wrinkling to Wrinkling Oils.** New Wrinkle Inc. and G. M. Williams. (V, p. 284.)

**Accelerators for the Curing of Hydrocarbon-substituted Polysiloxane Resins.** British Thomson-Houston Co. Ltd. (XIII, p. 293.)

## IV—RAW MATERIALS; INTERMEDIATES; COLOURING MATTERS

**Vapour-phase Production of Dimethylaniline.** T. H. Evans and A. N. Bourns. *Canadian J. Technol.*, **29**, 1–18 (Jan. 1951).

The formation of dimethylaniline by vapour-phase reaction of (*a*) aniline and methanol and (*b*) aniline and dimethyl ether has been investigated. The most efficient catalyst was activated alumina. Reaction (*b*) gave higher yields of purer product at lower temperatures. A quantitative yield of 99% pure dimethylaniline was obtained by passing 1 mole of aniline and 5 moles of dimethyl ether over activated alumina at 275–285°C. The construction and operation of a small pilot plant for the continuous production of dimethylaniline by this reaction is described. W. K. R.

**Molecular Compounds of Phloroglucinol and Tertiary Amines.** P. E. Verkade and M. van Leeuwen. *Rec. Trav. chim.*, **70**, 142–145 (Feb. 1951).

Phloroglucinol forms molecular compounds with certain tertiary amines when their solutions in water, ethyl

alcohol, or a mixture of these solvents are cooled. The preparation and analysis of 17 such compounds are reported. W. K. R.

**Preparation of Aromatic Azido Compounds by the Dutt–Wormall Reaction.** H. Bretschneider and H. Rager. *Sitzungsber. Öster. Akad. Wiss.*, **159**, (9–10), 970–980 (1950).

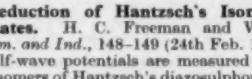
Diazotised sulphanilamide reacts with potassium cuprocyanide at pH 5–6 to give *p*-azidobenzenesulphonamide; i.e. the Sandmeyer replacement of $N_2$ by CN does not occur. This reaction also takes place in neutral and weakly alkaline medium. Only in acid medium of pH 1–4 can *p*-cyanobenzenesulphonamide be obtained. Azide formation may also take place without the addition of potassium cuprocyanide. The above formation of azido compounds appears to be a general reaction, and the yields are ~ 70%. H. H. H.

**New Aromatic Cyanotriazenes.** H. Bretschneider and H. Rager. *Sitzungsber. Öster. Akad. Wiss.*, **159**, (9–10), 981–987 (1950).

The alkali-metal salts of cyanotriazenes are prepared by the reaction of azido compounds (see previous abstract) with solid sodium cyanide in absolute ethanol. The coupling of the sodium salts of phenylcyanotriazene and of *p*-sulphamylphenylcyanotriazene with phenol is described. H. H. H.

**Polarographic Reduction of Hantzsch's Isomeric Diazosulphonates.** H. C. Freeman and W. P. Georgans. *Chem. and Ind.*, 148–149 (24th Feb. 1951).

Polarographic half-wave potentials are measured for a number of pairs of isomers of Hantzsch's diazosulphonates, and support earlier conclusions (Freeman and Le Fèvre, *J.C.S.*, 415 (1951)) that they form interconvertible *syn–anti* pairs—



(I) (II)

Type II are reduced at more negative potentials than I in accordance with the generally greater stability of II. An aq. soln. of the stable isomer is converted by sunlight or ultra-violet radiation to an equilibrium mixture with the labile form, the necessary irradiation causing a simultaneous photodecomposition. Reversion in the dark to the stable form can be followed polarographically. J. W. B.

**Hantzsch's Isomeric Diazosulphonates.** H. C. Freeman and R. J. W. Le Fèvre. *J.C.S.*, 415–428 (Feb. 1951).

Alkali salts of ten pairs of *syn-* and *anti*-diazosulphonates have been prepared, and exposure of their aqueous solutions to sunlight causes the production of the unstable from the stable forms accompanied by some irreversible decomposition. Thermal changes in the dark proceed in the direction— unstable → stable. Small differences of $\lambda$ and $\varepsilon$ are found between the ultra-violet spectra of the members of each pair. Attempts to make kinetic and other physical measurements are described. The configurational (*cis–trans*) explanation is preferred to the structural (sulphite–sulphonate) for this series of isomers. H. H. H.

**Substitution Reactions of the Naphthylenediamines. I— The Coupling of Diazobenzene to 1:5- and 1:8-Naphthylenediamines.** J. S. Whitehurst. *J.C.S.*, 215–221 (Jan. 1951).

The coupling of diazobenzene to 1:5- and 1:8-naphthylenediamines has been investigated over a range of pH values, and found to occur at position 2 in the former and at position 4 in the latter substance. In almost neutral solution, 1:8-naphthylenediamine tends to undergo bisazo coupling.

**II— The Bromination of the Ditoluene-*p*-sulphonyl Derivatives of 1:5- and 1:8-Naphthylenediamines.** Pp. 221–226.

**III— The Bromination of 1:5- and 1:8-Naphthylenediamines and Related Compounds.** Pp. 226–230.

H. H. H.

**The Coupling Reaction. III— Acid Strength and Coupling Mechanism of the Dihydroxynaphthalenesulphonic acids.** H. Zollinger and W. Büchler. *Helv. Chim. Acta*, **34**, 591–599 (March 1951).

From the dissociation constants of the hydroxyl groups of 2:3:6-, 2:8:6-, and 1:8:4-dihydroxynaphthalenesulphonic acids, and also of 1 : 8 : 3 : 6-dihydroxynaphthalenedisulphonic acid, it is concluded that in the two acids with the hydroxyl groups in the 1:8-position, a definite hydrogen bond is present between the two oxygen atoms. In the 2:8:6-acid there is no bond, and in the 2:3:6-isomer only a very weak one. The connection between the acid strength of the hydroxyl group and its influence on the coupling reaction is discussed. Conditional support is claimed for the hypothesis that in azo formation it is the diazonium ion which reacts with the phenoxide ion, although it is stated that coupling may occur otherwise in different circumstances. H. H. H.

**Nitration of *NN'*-Disubstituted Hydrazines.** J. P. Picard and J. L. Boivin. *Canadian J. Chem.*, **29**, 223–227 (Feb. 1951).

Nitric acid–acetic anhydride mixtures have been studied at − 30°c., − 20°c., − 10°c., 0·5°c., and room temperature for reaction with *NN'*-disubstituted hydrazines (R·NH·NH·R). When R = $CH_3$, $(CH_3)_2C(CN)$, $CH_3{\cdot}CO$, or $C_6H_5{\cdot}O{\cdot}CO$, azo derivatives are formed; whereas for R = HCO, nitrogen, carbon dioxide, and nitrogen oxides are evolved. An exception was observed with *NN'*-dibenzoylhydrazine, which, under the same conditions ($HNO_3$ (0·1 mol.), acetic anhydride (30 ml.), and hydrazine (0·025 mol.)), yielded the *NN'*-dinitro-*NN'*-dibenzoylhydrazine. This behaviour of *NN'*-disubstituted hydrazines appears to be dominated by their basic character and reducing power, and also to be dependent on the substituents. H. H. H.

**Power of Complex Formation of the Azo Derivatives of the Dihydroxynaphthalenesulphonic Acids.** H. Zollinger. *Helv. Chim. Acta*, **34**, 600–607 (March) and 992 (May 1951).

A qualitative comparison is given of the power to form complex compounds shown by 1:8:4-, 2:3:6-, and 2:8:6-dihydroxynaphthalenesulphonic acids and 1 : 8 : 3 : 6-dihydroxynaphthalenedisulphonic acid, and by some of the corresponding azo compounds of these acids with diazotised aniline and sulphanilic acid respectively. It is shown that the chromotropes may react in the enolic form, and so be related to the mordant dyes of the salicylic acid class and the alizarin lakes. For complex formation in the chromotropes, the existence of a resonance system in the chelate ring is of decisive importance in addition to the presence of hydrogen bonds. H. H. H.

**Preparation of 2-Amino-3-nitronaphthalene.** J. H. van Rij, P. E. Verkade, and B. M. Wepster. *Rec. Trav. chim.*, **70**, 236–240 (March 1951).

Doubt is expressed regarding the purity of preparations of 2-amino-3-nitronaphthalene (I) previously reported in the literature. The preparation of I, in the form of bright red crystals, m.p. 115–116°c. (acetyl derivative, m.p. 129–130°c.), by the partial reduction of 2:3-dinitronaphthalene with sodium disulphide is described. W. K. R.

**Preparation and Reactions of 2:4:8-Trinitro-1-naphthylamine.** E. R. Ward and L. A. Day. *J.C.S.*, 782–787 (March 1951).

2:4:8-Trinitro-1-naphthylamine is obtained by nitration of 8-nitro-1-toluene-*p*-sulphonamidonaphthalene in acetic acid, followed by hydrolysis in sulphuric acid. Its reactions show the effect of steric hindrance from the 2- and the 8-nitro group. An improved procedure for obtaining 8-nitro-1-naphthylamine from the nitration products of α-naphthylphthalimide by Hodgson and Ratcliffe's method (*J.C.S.*, 1314 (1949)) is reported, and applied to the hydrolysis of the similar products from β-naphthylphthalimide. H. H. H.

**Sulphonation of 1-Naphthol-3:6-disulphonic Acid (A Further Exception to the Armstrong–Wynne Rule).** L. Blangey, H. E. Fierz-David, J. C. Ulrich, and H. Bretscher. *Helv. Chim. Acta*, **34**, 501–521 (March 1951).

1-Naphthol-2:3:4:6-tetrasulphonic acid has been prepared by energetic sulphonation (30% oleum at 125°c.) of 1-naphthol-3:6-disulphonic acid, and its behaviour towards acids, alkalis, and ammonia investigated. The above reaction contradicts the Armstrong–Wynne rule, since not only two but three sulpho groups are adjacent, and exhibit quite extraordinary reactivity as a consequence. Thus the

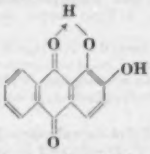
3-sulphonic acid group is replaced by the hydroxyl group with dilute alkalis, while dil. HCl easily removes the 2- and 4-sulpho groups. With ammonia and ammonium sulphite (Bucherer), 1-amino-3-naphthol-2:4:6-trisulphonic acid is first obtained, and then 1:3-diaminonaphthalene-2:4:6-trisulphonic acid. H. H. H.

**Canarin.** G. Torinus. *Melliand Textilber.*, **31**, 847–848 (Dec. 1950).

The yellow colouring matter canarin can be produced directly on the fibre by applying a mixture of 4 parts of ammonium thiocyanate and 3 parts of an alkali-metal chlorate, and can also be used in both direct and resist printed styles. H. K.

**Preferential Acylation of the β-Hydroxyl Group in 3-Nitroalizarin.** R. Gonsalves, A. N. Kothare, and V. V. Nadkarny. *J. Indian Chem. Soc.*, **27**, 527–530 (Oct. 1950).

Acylation (acetylation and benzoylation) of 3-nitroalizarin in pyridine at 100°c., using equimolar quantities of acyl chloride and nitroalizarin, gives 2-acyl-3-nitroalizarin. The relative inactivity of the α-OH group is probably due to chelation—




since the observed increased activity of the leuco derivative supports such an assumption. Further supporting evidence is the difficulty of methylating the α-OH group by the usual alkylating procedures, and its facilitation by conversion to the leuco compound. H. H. H.

**Hydrocarbons formed by Zinc Dust Distillation of Benzanthrone—I.** A. Zinke, R. Ott, and E. Weinhardt. **II.** A. Zinke and R. Ott. *Sitzungsber. Oster. Akad. Wiss.*, **159**, (8), 878–886; (9–10), 1137–1140 (1950).

**I**—It is reported that the course of the zinc dust distillation of benzanthrone is dependent on the reaction temperature. Thus benzanthrene and dihydrobenzanthrene are formed below 400°c., and only benzanthrene at about 600°c. Certain coloured hydrocarbons are also obtained as by-products, and a yellow compound (I) has been orientated.

**II**—Three other hydrocarbons are orientated from the by-products reported in Part I, viz. II (or III), IV, and V.

(I)

(II)

(III)

(IV)

(V)

H. H. H.

**Newer Dyes—II.** W. Seidenfaden. *Melliand Textilber.*, **31**, 839–843 (Dec. 1950).

Some of the recent patents relating to vat, sulphur, and phthalocyanine dyes are reviewed. H. K.

**Hyperconjugation and Light Absorption.** M. Pianka, H. C. Barany, and C. G. Smith. *Nature*, **167**, 440 (17th March 1951).

The replacement of the hydrogen of a methin group in a number of conjugated organic compounds by an alkyl radical causes a batho- or hypso-chromic shift in the principal absorption maxima, an effect particularly noticeable in methyl substitution. Examples are—a hypsochromic shift of 300 A. in the absorption maximum of phenyl methyl ketazine on that of benzylideneazine, due to the contribution of a shorter conjugated form—

$$H_2C{\cdot}C(C_6H_5){:}N{\cdot}N{:}C(C_6H_5){\cdot}CH_3$$

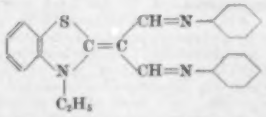
to the total resonance system; the absorption maximum of the 2:4-dinitrophenylhydrazone of acetaldehyde in ethanol shows a bathochromic shift of 120 A. on that of its formaldehyde analogue, whereas the three consecutive homologues show one of only 90 A.; thia- and selena-carbocyanines with an alkyl group substituted in the central position of their three-carbon methin chain show a hypsochromic shift on those of the unsubstituted compounds, which is most pronounced with the methyl substituent. This hypsochromic shift does not appear in the oxacarbocyanines, in which there is the possibility of an annulment of the hyperconjugative effect of the alkyl group. The hypsochromic effect cannot be ascribed to steric hindrance, and the shift is explained by hyperconjugation due to the methyl group. H. H. H.

**Fluorescence Quenching by Colloid Anions and Cations.** J. E. Lovelock. *J.C.S.*, 115–120 (Jan. 1951).

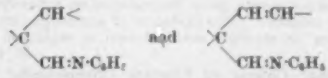
The fluorescence of solutions of dichlorofluorescein as the free acid and Rhodamine 6G as chloride is quenched by the addition of small quantities of the colloid anion sodium polyvinyl sulphate, prepared by treating polyvinyl alcohol with chlorosulphonic acid–pyridine, and of the colloid cation poly-(1-methyl-2-vinylpyridinium iodide), prepared by exposing redistilled 2-vinylpyridine to ultra-violet radiation in a quartz cell at room temperature for several days, respectively. The magnitude of the effect and its reversal by electrolytes are described. The fluorescence-quenching phenomena, which resemble the metachromatic effect, could be explained by the aggregation of fluorescent dye molecules by the colloid ions, but the ready reversal by ions of the same sign as the dye ion suggests that adsorption of the dye by the colloid ion, rather than aggregation, is responsible. The linear relation over a wide range of values of salt adsorbed with concentration of ion is in accord with the Freundlich adsorption isotherm, and appears to confirm the above assumption. H. H. H.

**Some Trinuclear Cyanine Dyes. IV—Action of Acid on Dinuclear Intermediate Dyes.** F. M. Hamer. *J.C.S.*, 294–299 (Feb. 1951).

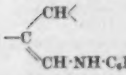
Dinuclear intermediate dyes were obtained by condensing one molecule of a heterocyclic dianil, such as —



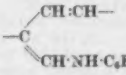

with one molecule of a compound having a reactive methylene group, whereas condensation with two molecules gave the trinuclear dyes themselves. According as the reactive methylene groups were cyclic or in the form of external methyl groups, these intermediate compounds fell into two classes characterised, in one of the resonating structures, by the groups—




respectively. Of seven dinuclear intermediate dyes having the former group, four gave hydrochlorides having the group—



on more drastic treatment with acid, three gave the corresponding dimethin*mero*cyanine having the chain >CH·CH<. Five dinuclear dyes having the second group above gave perchlorate hydroperchlorates having the group—



on more drastic treatment with acid, four gave the corresponding trimethincyanines having the chain >CH·CH:CH—. H. H. H.

**Simple *mero*Cyanine from Enolisable 1 : 3-Diketones.** W. Jenny. *Helv. Chim. Acta*, **34**, 539–554 (March 1951).

2-Acetyl-1-naphthol and 2-acetyl-3-hydroxythionaphthen condense with aldehydes in the presence of boron pyroacetate (from boric acid and acetic anhydride) to give deeply coloured boron complexes. Also by removal of water from 2-*o*-hydroxybenzylideneacetyl-1-hydroxynaphthalene and 2-*o*-hydroxybenzylideneacetyl-3-hydroxythionaphthen, some new coloured benzopyran derivatives have been prepared. Finally, the condensation of 2-acetyl-1-naphthol and 2-acetyl-3-hydroxythionaphthen with *o*-amino- and with *o*-methylaminobenzaldehyde in alcoholic NaOH, or in piperidine, leads directly, by double removal of water, to deeply coloured dihydroquinoline and *N*-methyl-dihydroquinoline derivatives. The relationship between the constitution and optical behaviour of these new colouring matters is discussed. H. H. H.

**Melanin and its Precursors. II— Model Experiments on the Reactions between Quinones and Indoles, and Consideration of a Possible Structure for the Melanin Polymer.** J. D. Bu'Lock and J. Harley-Mason. *J.C.S.*, 703–712 (March 1951).

With certain exceptions, which are discussed, indoles unsubstituted in the 3-position condense with *o*- and *p*-benzoquinone and with 1:2- and 1:4-naphthaquinone to give intensely coloured indolylquinones. In certain cases these can react at the 2-position, if free, with a further molecule of quinone. With 3-methyl- and 2:3-dimethylindole, *p*-benzoquinone gives colourless products. The mechanism of these reactions is discussed. The failure of 2:5- and 2:6-dimethyl-1:4-benzoquinones, 4:5-dimethyl-1:2-benzoquinone, and 2-methyl-1:4-naphthaquinone to react with indoles is probably due to steric hindrance. A polymeric structure formed by self-condensation of indole-5:6-quinone at the 3- and the 7-position, with cross-links involving reaction at the 2-position, is advanced for melanin. H. H. H.

**Chemistry of Adrenochrome. II— Some Analogues and Derivatives.** J. D. Bu'Lock and J. Harley-Mason. *J.C.S.*, 712–716 (March 1951).

Oxidation by potassium iodate of the three adrenaline analogues— noradrenaline, *a*-methylnoradrenaline, and *N*-*iso*propylnoradrenaline— gives red crystalline iodoquinones, which are isomerised on treatment with acetic anhydride–pyridine, and then afford acetylated 3:5:6-trihydroxy-2-iodoindoles, from which the iodine atom can be removed by reduction with zinc dust and acetic acid. Hydrolysis then yields yellow, intensely fluorescent 3:5:6-trihydroxyindoles. Oxidation of adrenaline with potassium ferricyanide in the presence of sodium hydrogen carbonate proceeds much more rapidly and efficiently than with buffered persulphate. An explanation is advanced of the fact that adrenaline analogues containing a primary amino group do not give a green fluorescence on autoxidation in alkaline solutions. The oxidation of adrenaline, and of its analogues, in strongly acid solution is explained. H. H. H.

**Abnormal Colour of Chelate Compounds.** P. Krumholz. *Nature*, **167**, 570 (7th April 1951).

A large number of deeply coloured chelate compounds are known, the components of which show no, or only weak, absorption in the visible region. Typical examples are the Ni complex of dimethylglyoxime and the ferrous tri-*aa'*-dipyridyl and tri-*o*-phenanthroline ions. As such complexes are diamagnetic, thereby having closed electronic shells on the metal atom, it is highly improbable that their abnormally deep colour is due to electronic transitions within the metal atoms, and it can only be attributed to the co-ordinated molecules. The ultra-violet spectrum of the ferrous tri-*aa'*-dipyridyl ion is similar to the spectrum of *aa'*-dipyridyl and its salts, and is probably due to slightly modified transitions within the individual co-ordinated molecules, while the visible spectrum is due to transitions of a similar kind involving the entire polynuclear chelate system. H. H. H.

**Colour Changes in Solutions of Chromic Salts.** E. Justin-Mueller. *Melliand Textilber.*, **31**, 838 (Dec. 1950).

The colour changes associated with solutions of chromic salts are explained on the basis of a reversible molecular transformation. H. K.

PATENTS

**Acetonitriles as Azo Components in Diazotypes.** General Aniline & Film Corpn. and S. C. Slifkin. *U.S.P.* 2,531,004.

Compounds of formula $R\text{-}CH_2\text{-}CN$ (R = a strongly negative radical) used as azo components give greatly improved stability to precoupling, while the rapidity with which they couple to form azo dyes approaches that of the acylacetarylides. C. O. C.

**6-Nitro-4-keto-1:2:3:4-tetrahydro-2-naphthoic Acid.** I.C.I. Ltd., W. F. Beech, and N. Legg. *B.P.* 651,585.

Nitration of 4-keto-1:2:3:4-tetrahydro-2-naphthoic acid using a mixture of nitric and sulphuric acids gives the 6-nitro derivative. The starting material is obtained from benzylsuccinic acid by treatment with $AlCl_3$ in presence of nitrobenzene according to the method of Haworth, Jones, and Way (*J.C.S.*, 10 (1943) ), but as 4-nitrobenzylsuccinic anhydride could not be obtained, the required 6-nitro-4-keto-1:2:3:4-tetrahydro-2-naphthoic acid could not be made by this route.

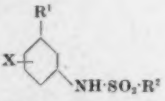
Bromination of the 6-nitro compound, followed by dehydrobromination with diethylaniline, yields 4-hydroxy-6-nitro-2-naphthoic acid, which on reduction with e.g. hydrogen in presence of Raney Ni gives 6-amino-4-naphthol-2-carboxylic acid. E. S.

**Diazotype Printing.** General Aniline & Film Corpn. and F. W. Neumann. *B.P.* 651,690.

Aliphatic nitro compounds having a nitro group attached to an aliphatic C atom carrying at least one active H atom react with light-sensitive diazo compounds to yield images of good colour density and a variety of hues. C. O. C.

**Colour Formers for Non-migratory Azine Dyes.** General Aniline & Film Corpn. and A. C. Starke, Jr. *B.P.* 651,958.

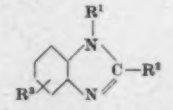
Compounds of formula—



($R^1$ = primary amino, alkylamino, dialkylamino, or OH; $R^2$ = Alk of > 9 C or an aromatic radical substantive to gelatin or containing an Alk of > 9 C; X = $R^2\text{-}SO_2\text{-}NH$–) yield non-migratory azine dyes by colour-forming development. C. O. C.

**Cyan Colour Formers.** General Aniline & Film Corpn. and W. C. Craig. *U.S.P.* 2,530,349.

Compounds of formula—



($R^1$ = an aliphatic chain of > 9 C; $R^2$ = a subst. or unsubst. hydroxyaromatic radical whose OH group is

directly linked to a nuclear C atom; $R^3$ = a water-solubilising group) used as colour formers in colour photography yield images of exceedingly fine grain. C. O. C.

**Colour Couplers containing a Methylene or Phenolic Methenyl Group and a Terphenyl Radical.** Kodak Ltd. and C. F. H. Allen. *B.P.* 651,424.

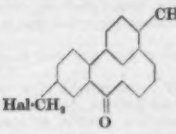
Colour couplers for use with primary aromatic amine developers contain a methylene group, or a methin group forming part of a phenolic ring, and are substituted, except at the reactive group, by a terphenyl radical which itself may be substituted. They do not tend to crystallise in or diffuse from photographic emulsions. C. O. C.

**Diazotype Photoprinting Materials containing Aldehyde Reaction Products of Dihydroxyaryl Compounds.** General Aniline & Film Corpn., W. H. von Glahn, and L. N. Stanley. *B.P.* 651,691.

Compounds of formula $(OH)_2R^1{\cdot}CHR^2{\cdot}R^1(OH)_2$ ($R^1$ = subst. or unsubst. aryl; $R^2$ = H, Alk, or the radical of a sugar aldehyde) are used as coupling components in diazotype printing. C. O. C.

**Bishalogenomethylbenzanthrones.** General Aniline & Film Corpn., D. I. Randall, and S. R. Buc. *U.S.P.* 2,531,464.

3:9-Bishalogenomethylbenzanthrone—



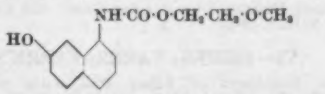
is readily obtained in almost quantitative yield by treating benzanthrone with dihalogenodimethyl ether in a co-solvent for both, e.g. conc. $H_2SO_4$, while maintaining continuously excess of the dihalogenodimethyl ether. C. O. C.

**Halogenomethyl-3-halogenobenzanthrones.** General Aniline & Film Corpn., D. I. Randall, and S. R. Buc. *U.S.P.* 2,531,465.

9-Halogenomethyl-3-halogenobenzanthrone is readily obtained in quantitative yield by treating 3-halogenobenzanthrone with dihalogenodimethyl ether in a solvent for both at 30–80°C. C. O. C.

**Chromable Monoazo Dyes derived from *O*-Alkylglycol Esters of 7-Naphthol-1-carbamic Acid.** Sandoz Ltd. *B.P.* 651,993.

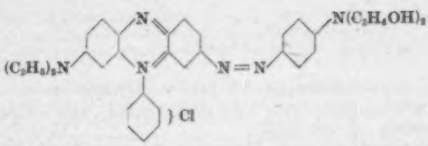
Dyes which may be chromed in substance or on the fibre are made by coupling diazotised *o*-aminophenolsulphonic acids with *O*-alkylglycol esters of 7-naphthol-1-carbamic acid. They contain in the 1-position the group NH·CO·O·Alkylene·O·Alk, and have greater solubility than the similar dyes of *B.P.* 588,771 (J.S.D.C., **63**, 358 (Nov. 1947)), which have the group NH·COOAlk in the 1-position. Thus 1-amino-7-naphthol reacts with the methylglycol ester of chloroformic acid to give β-methoxyethyl 7-hydroxy-1-naphthylcarbamate—



which couples with diazotised 4-chloro-2-aminophenol-6-sulphonic acid in presence of soda ash to yield a blue-grey dye which can be applied to wool by the neutral single-bath chroming process. E. S.

**Safranine-Azo Dyes for Leather.** General Aniline & Film Corpn. and J. J. Hayden. *B.P.* 651,065.

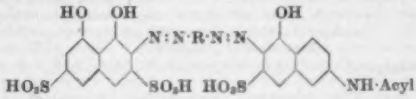
Dyes possessing brilliance of hue and good penetrating properties for leather are made by diazotising a suitable safranine compound and coupling with an *N*-hydroxyalkyl aromatic amine of formula $ArNR^1R^2$ ($R^1$ = hydroxyalkyl of > 1 C; $R^2$ = H, Alk, aryl, aralkyl, or hydroxyalkyl of > 1 C; Ar is an aryl nucleus unsubst. in the *para* position to the amino N). Thus Methylene Violet 3 RA (*C.I.* 842) is diazotised and coupled under acid conditions with *NN*-bishydroxyethylaniline to yield a dye of probable constitution—



which gives bright, well penetrated greenish blacks on chrome leather. E. S.

**Substantive Disazo Dyes containing Copper.** Ciba Ltd. *B.P.* 651,917.

Substantive disazo dyes are made by treating compounds of general formula—



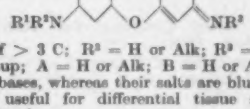
(R = a benzidine residue containing 3:3′-dialkoxy groups) with an agent yielding copper so that the alkoxy groups are split off. The alkoxy groups preferred are methoxy or ethoxy, and the acyl group is preferably aromatic, e.g. benzoyl or *p*-chlorobenzoyl. Thus tetrazotised *o*-dianisidine is coupled, first with an alkaline solution of 1 mol. of 1:8-dihydroxynaphthalene-3:6-disulphonic acid, and then with an alkaline solution of 1 mol. of 2-benzoylamino-5-naphthol-7-sulphonic acid. The disazo compound so produced is salted out, and heated with aqueous ammoniacal copper sulphate to yield a greenish dark blue direct cotton dye. E. S.

**Photosensitive Leuco Cyanides of Triarylmethane Dyes.** L. Chalkley. *U.S.P.* 2,528,496.

The leuco cyanides of triarylmethane dyes are not sensitive to light in their pure solid form, it being only in solution that they respond to light by the formation of dyes, the nature of the solvent exercising a determining influence upon the sensitivity of the solution to light. Use as the solvents of carboxylic acids which transmit light or ultra-violet radiation of 2100–3800 A., e.g. acetic acid, is better than the use of alcohols, as the solutions are less volatile, can be made more concentrated, and yield on exposure to ultra-violet radiation colours which do not fade in the dark. C. O. C.

**9-Dialkylamino-5-arylamino[a]phenoxazines.** American Cyanamid Co., M. L. Crossley, P. F. Dreisbach, R. J. Turner, and C. M. Hofmann. *U.S.P.* 2,528,863.

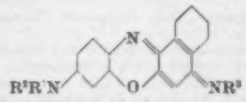
Dyes of formula—



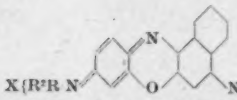
($R^1$ = Alk of > 3 C; $R^2$ = H or Alk; $R^3$ = homocyclic aromatic group; A = H or Alk; B = H or Alk) give red solutions as bases, whereas their salts are blue. They are particularly useful for differential tissue staining for microscopic work. C. O. C.

**9-Propylalkylamino-5-arylaminobenzo[a]phenoxazines.** American Cyanamid Co., M. L. Crossley, R. J. Turner, and P. F. Dreisbach. *U.S.P.* 2,528,862.

The free bases of the above dyes are red and probably have the formula—



($R^1$ = $C_2H_5$; $R^2$ = $C_2$ or $C_3$ Alk; $R^3$ = monocyclic aromatic hydrocarbon radical). Their addition salts are blue and probably have the formula—



(X = an anion). They have extraordinarily high activity against tubercle bacilli. C. O. C.

**Converting Loose, Flocculent Furnace Black into Dustless, Readily Friable Pellets.** Columbian Carbon Co. and R. L. Gholson. *B.P.* 652,139.

**White Barytic Pigment.** L. Schloesser. *B.P.* 651,971.

A white pigment suitable as a substitute for white lead, zinc white or grey, barium sulphate, lithopone, titanium dioxide, red lead, litharge, or the like is obtained by mixing aq. sodium sulphate and silicate with enough aq. barium chloride to convert all the sodium salts into barium salts. The precipitated barium salts are washed, dried at not > 150°c., ground, and pulverised. C. O. C.

**Lithopone.** Orr's Zinc White Ltd., H. Mills, and H. Ford. *B.P.* 651,819.

In making lithopone, formation of calcium sulphide during calcination is prevented by use of a slight excess of soluble zinc in the coprecipitate before calcining in a way which eliminates soluble calcium sulphide but which does not introduce free sulphuric acid.

*B.P.* 651,820.

Air is admitted to the calcining furnace in a controlled manner in order to eliminate calcium sulphide while maintaining formation of zinc oxide due to admission of air at a minimum value.

*B.P.* 651,821.

The calcined powder is quenched with water to form a slurry, and sulphuric or other mineral acid added until the slurry reacts acid. This dissolves the soluble calcium sulphide. C. O. C.

**Magnesium Ferrite Pigment.** Columbian Carbon Co., C. D. Downs, and J. Martin. *B.P.* 651,347.

In preparing magnesium ferrite by mixing synthetic ferric oxide, ferric oxide hydrate, or ferrosoferric oxide with magnesium oxide or carbonate and water, drying, and then heating, addition of not > 1% of a halide salt, e.g. $MgCl_2$, gives complete reaction at a lower temperature and in a much shorter time. The product is a buff pigment whose colour does not change on heating to > 200°c. C. O. C.

**High-value Titanium Dioxide Pigments.** Spolek pro Chemickou a Hutni Vyrobu N.P. *B.P.* 651,729.

Use of readily soluble complex salts of titanium, e.g. $(NH_4)_2TiCl_6$ (obtained by adding $NH_4Cl$ to a sulphuric acid solution of a titanium salt and introducing HCl at 2°c.), for seeding sulphuric acid solutions of titanium salts yields hydrolysis products which are readily convertible to the rutile form.

*B.P.* 652,268.

Rutile $TiO_2$ is obtained by precipitating a readily soluble alkali-metal (or ammonium) titanium halide from a solution of titanium sulphate and then heating a dil. aq. solution of this precipitate to 80°c. to hydrolyse it. C. O. C.

**[Pigments for] Coatings for Rubber Goods.** H. Hadert. (XIII, p. 292.)

**Optical Properties of Pigments as related to their Use in Rubber.** C. E. Barnett and H. C. Jones. (XIII, p. 292.)

## V— PAINTS; ENAMELS; INKS

PATENTS

**Zeolites as Flatting Agents.** Lewis Berger & Sons Ltd. *B.P.* 651,977.

The calcium and magnesium zeolites obtained from the "fines" produced as waste in the manufacture of zeolite ion exchangers can be used as flatting agents. C. O. C.

**Flatting Agent.** U.S. Industrial Chemicals Inc. and K. A. Earhart. *B.P.* 651,302.

A fossil, semi-fossil, or semi-recent Congo resin having a direct acid number > 60 is dispersed in hot aqueous alkali-metal hydroxide, and then a water-soluble salt of Al, Mg, Sr, Ca, Ba, Zn, or Zr is added to the dispersion. The product retains its initial colour and does not darken when exposed in thin films of coating compositions, and does not lose its flatting properties on ageing. C. O. C.

**Paints containing Organic Silicates.** Silicon (Organic) Developments Ltd., W. E. Langrish-Smith, C. Shaw, and D. A. W. Hill. *B.P.* 652,136.

Organic bases of $pK_a$ value 7·8 or more, although catalysts for the hydrolysis of organic silicates, nevertheless do not exert this effect for a considerable period provided the amount of water present is small. Thus they can be used in paints which will store well without gelling, but which quickly gel on addition of water, e.g. on exposure of a film to the atmosphere. C. O. C.

**Polymerising Non-wrinkling to Wrinkling Oils.** New Wrinkle Inc. and G. M. Williams. *U.S.P.* 2,528,936, *U.S.P.* 2,528,937.

Drying oils which are normally non-wrinkling have their drying rate accelerated while simultaneously being rendered wrinkling by incorporating into them organo-metallic compounds and metallic ions, e.g. by adding $CaC_4H_6$, Na, or Cu. This catalyst initiates polymerisation and eliminates the necessity for the initial formation of polar bodies by oxidation of the oil. C. O. C.

**Drying Printing Inks.** Meyercord Co., C. E. Thorp, and L. C. Kinney. *U.S.P.* 2,528,850.

Inks containing the usual drying and semi-drying oils are very rapidly hardened by the action of sulphur dichloride, so much so that the hardening step can be incorporated into the usual printing operations without slowing them down. Suitable apparatus is described. C. O. C.

**Writing Inks.** Parker Pen Co. and G. H. Sayler. *U.S.P.* 2,528,390.

Addition of 0·005% by weight of a copper inhibitor, e.g. disalicylalethylenediamine, to inks containing cupriferous dyes or traces of copper as impurity prevents degradation of the rubber parts of pens. C. O. C.

**Polytetrafluoroethylene Coatings.** du Pont. *B.P.* 650,399.

Coatings, e.g. on wire, of polytetrafluoroethylene prepared from an aqueous dispersion of the resin followed by baking of the coating show improved adhesion and abrasion resistance when the dispersion contains 5–50% on the weight of the resin of a dispersion of a hydrous oxide, e.g. silica sol. E. C.

**Pentaerythritol Polyesters— Coatings.** I.C.I. Ltd. and S. F. Marrian. *B.P.* 650,002.

Mono-, di-, or poly-pentaerythritols (1 mol.) are heated with excess of a dialkyl carbonate (1–6 C per alkyl group) in presence of a sodium alkoxide catalyst, and alcohol is removed by distillation. The resinous products are suitable for use in coatings either alone or with cellulose nitrate. E. C.

**Silicone-modified Alkyd Resins.** British Thomson-Houston Co. Ltd. *B.P.* 650,247.

An oil-modified alkyd resin containing free hydroxyl groups is heated in presence of a solvent, e.g. xylene, with 0·05–20% of a polysiloxane resin, e.g. from the controlled hydrolysis of phenyltributoxysilane, and alcohol and water are recovered by distillation. The products are suitable for use as heat-, light-, and chemically resistant coatings. E. C.

**Siloxane Resins.** Dow Corning Corpn. and E. J. Smith. (XIII, p. 294.)

## VI— FIBRES; YARNS; FABRICS

**Some Relations of Fibre Properties to Fabric Handle.** R. M. Hoffman and L. F. Beste. *Text. Research J.*, **21**, 66–77 (Feb. 1951).

The property of handle of a fabric is discussed with special reference to several concepts which have recently been developed in which certain fibre properties have been linked to particular features of fabric handle. Fabric stiffness is governed chiefly by the elastic modulus, lateral dimensions, and cross-sectional shape of the fibre. "Compliance", which is not exactly the opposite of stiffness, is believed to be associated with the ease of extension of fibres at high elongations, e.g. 5–10%. A device is described which measures fabric "liveliness", a property that is related to the square root of fabric flexural rigidity. Leanness and bulk of fabrics are governed mainly by yarn density and cover factor, although raising a surface nap also increases bulkiness. "Waxiness" is a property attributed to the relative order of tensile and torsional

moduli of the constituent fibres. Fibres of low shear or torsional modulus compared with the tensile modulus are thought to give fabrics having a waxy feel. Drape, contour retention, and resilience are also discussed. It is concluded that the three basic fibre properties governing the handle, liveliness, and shape retention of fabrics are the initial stiffness, the change in stiffness as the load is increased, and the recovery behaviour on removal of the load. P. C.

**Chemical Composition of Cotton.** E. R. McCall and J. F. Jurgens. *Text. Research J.*, **21**, 19–21 (Jan. 1951).

Analytical data are given for cellulose content, total sugars and reducing sugars, nitrogen, wax, ash, ash alkalinity, pH of water extract, and the several organic acids present for six commercial raw cotton samples. Fibre physical properties are also quoted. P. C.

**Cellulose Fibres. XV—Decomposition of Cotton Cellulose with NaOH.** K. Lauer. *Kolloid-Z.*, **121**, 33–36 (Feb. 1951).

Measurement of the absorption of NaOH by a standard cellulose from American cotton-linters, and by pretreated materials, leads to the following conclusions—(1) Absorption of 0·1–0·25 mol. NaOH per glucose residue takes place from NaOH solutions of up to 10% strength. (2) From 10–15%, the inner surface of the fibre is altered by dissolution of OH-groups from the 2-positions of the crystalline zone; the remaining mercerised cellulose has 0·5 mol. OH-groups in 2-position which can form a compound with NaOH, and 0·25 mol. in 3-position, which xanthate after the OH-groups in 2-position have reacted. These results are claimed to explain compound formation of cellulose with NaOH as an intermediate stage of xanthation, and why mercerised celluloses can give soluble xanthates with 10% NaOH. There are 16 references. H. H. H.

**Cellulose Fibres. XVI—Structure of the Cotton Fibre.** K. Lauer. *Kolloid-Z.*, **121**, 36–39 (Feb. 1951).

From consideration of data obtained from standard American cotton celluloses for absorption of dyes (Congo Red, Benzopurpurin, and Chrysophenin) and of 10% and 16% NaOH, also for xanthation, acetylation, and methylation using KOH, NaOH, and quaternary bases, it is concluded that water does not penetrate the crystalline zone of the native fibre, so that for hydrate formation the necessary OH groups must be present in the amorphous part of the fibre. It is believed that the cellulose crystal surface contains molecules or parts of molecules which possess no free OH groups, and, from the chemical and physical data, it would appear that ~ 2 OH groups are available for reaction, e.g. with water, in the glucose residue of the amorphous region. As soon as a hydrated cellulose is formed, whether by mercerisation or in a spinning process, the fibre possesses three zones—viz. a crystalline, a semi-crystalline, which contains the reactive OH groups, and an amorphous zone. There are 25 references. H. H. H.

**Morphology of the Cotton Fibre. I—The Primary Wall and its Behaviour on Alkaline Boiling.** W. Kling and H. Mahl. *Melliand Textilber.*, **32**, 131–136 (Feb. 1951).

Examination of cotton fibres under the electron microscope reveals extensive signs of attack following kier boiling and bleaching. As a result experiments were carried out to ascertain the effects of extraction with organic solvents, chlorine bleaching, and prehydrolysis with acid followed by an alkali boil. Fresh information was thereby obtained on the structure of the cotton fibre, more especially of the fibre wall. It was further confirmed that the primary wall of the cotton fibre is removed to a great extent by the usual alkali boil under pressure. This energetic attack on the fibre structure should therefore be avoided if at all possible. B. K.

**Effect of Changes in Crystalline Structure on the Infra-red Absorption Spectrum of Cellulose.** F. H. Forziati and J. W. Rowen. *Bur. Stand. J. Res.*, **46**, 38–42 (Jan. 1951)—*Research Paper* 2172.

Celluloses having the X-ray diffraction pattern of the native or type I cellulose were compared with that obtained from regenerated or mercerised celluloses (type II) by means of their infra-red absorption spectra. Type I celluloses showed sharper absorption bands than type II, the most striking differences being found in the 7–8 and 9–10 $\mu$ regions. Factors other than decrease in crystallinity of type I may contribute to these differences, but the changes may prove useful in evaluating the relative crystalline structure. W. J. M.

**Fractionation of Cellulose by a Summative Method.** S. Coppick, O. A. Battista, and M. R. Lytton. *Ind. Eng. Chem.*, **42**, 2533–2538 (Dec. 1950).

The method described applies primarily to the fractionation of cellulose in a sodium hydroxide–solvent system. The cellulose is first dissolved in alkali and then partly precipitated with acetone. The precipitate is separated by centrifuging, and the cellulose is then quantitatively precipitated from an aliquot of the supernatant liquor, so that the % weight of polymer remaining in solution $F$ can be calculated. The degree of polymerisation of the fraction precipitated $P$ is determined in cuprammonium hydroxide solution, and the process is repeated several times varying the composition of the acetone–water precipitant. The plot of the values of $F$ against $P$ gives the summative distribution curve. Integral and differential distribution plots have been derived mathematically, and an examination of a series of wood pulps and cotton linters for rayon manufacture shows that the chain length distribution of the linters pulp was more homogeneous than that of the wood pulp. H. K.

**Micelle Form of Hydrated Cellulose.** E. Treiber. *Sitzungsber. Oster. Akad. Wiss.*, **159**, (9–10), 1007–1016 (1950).

Within the normal technical spinning conditions, the micelle form and dimensions are practically uninfluenced by concentration changes of the cellulose. Marked deviation from the standard values, however, produces inferior micelles with decreasing concentration, and *vice versa*. This may necessitate different conditions for the precipitation of regenerated viscose. Normal threads from the ammoniacal copper process exhibit relatively good micelle formation, but threads from zinc chloride solutions are inferior to those prepared by the normal Hermans procedure. The paper is preceded by a discussion of X-ray data. There are 3 diagrams and 25 references. H. H. H.

**Hygroscopicity and Shrinkage in Water of Hydrate-cellulose Rayon.** A. B. Pakshver, S. S. Frolov, and N. N. Filatova. *Tekstil. Prom.*, **10**, 18–20 (Dec. 1950).

Viscose rayons (normal and high-tenacity) and cuprammonium rayons (funnel-spun and alkali-spun) were examined for solubility in 10% NaOH, for hygroscopicity (water-uptake in an atmosphere of 100% R.H.), and for change in length on immersing in water or in 4% NaOH at 20°c. The last measurement was done under various degrees of tension. Some of the samples had been maintained continuously in the wet state throughout the operations following spinning, and were dried, before testing, under various degrees of tension and at various temperatures. Others were treated in 4% NaOH or in boiling water before testing. The results, which are tabulated, are interpreted qualitatively on the basis of changes in degree of intermolecular linkage. It is suggested that the quantity $S = L - l$ (where $L$ is the increase (12·5%) in the length of unloaded unoriented rayon when immersed in water, and $l$ is the actual increase in length of the rayon under examination when immersed, unloaded, in water or in NaOH soln.) is a measure of the intermolecular forces, as weakened by the water or the NaOH soln. For normal viscose rayon in water $S$ is 10·65, while after treating the rayon in 4% NaOH it is 1–2. For a high-tenacity rayon it is 10–11, reduced to 5·5–6·5 by treatment in 4% NaOH. For alkali-spun cuprammonium rayon $S$ is 8·4, for funnel-spun it is 9·8. A. E. S.

**X-Ray Study of Deformation Processes in Hermans' Cellulose Hydrate Fibres.** O. Kratky, G. Porod, and E. Treiber. *Kolloid-Z.*, **121**, 1–21 (Feb. 1951).

Limiting cases of orientation mechanisms previously designated I (cf. *ibid.*, **64**, 213 (1933)) and II (cf. *ibid.*, **84**, 149 (1938)) for the interpretation of fibre deformation are now more comprehensively discussed with respect to X-ray data, and applied to the case of Hermans' cellulose hydrate fibre. For the latter, experimental data are given for deformation experiments within the range of 1–14% viscose concentration, for both freshly prepared and regenerated fibres. Comparison of experimental and

theoretical data calculated from I and II respectively indicates I to afford a good discussion basis. There are 15 diagrams and curves together with 23 references.
H. H. H.

**Stretching Process of Artificial Cellulose Fibres.** P. H. Hermans and W. Kast. *Kolloid-Z.*, **121**, 21–32 (Feb. 1951).

Two independent methods are available for the complete description of the state of orientation of lamina-forming particles, viz. the half-breadth parameter method of Kast and the variation-square procedure of Hermans; both are now discussed and extended with respect to the stretching process of artificial cellulose fibres, and to the Kratky theory of orientation for rod- and lamina-forming particles. A comparison of observed with calculated data for different stretching processes, and also during the course of the same procedure, reveals different relationships for axial and planar orientation. The rod and laminar cases are found to be limiting ones, and the data obtained to be explained as intermediate values. There are 9 sets of data curves and 25 references.
H. H. H.

**Cuprammonium Solutions of Cellulose. IV — Reactivity of certain Polyhydroxy Compounds in Cuprammonium Solution and its Dependence on the Concentration of Ammonia.** M. I. Arkhipov and A. N. Bykov. *J. Appl. Chem. (U.S.S.R.)*, **24** 102–112 (Jan. 1951).

The reactivities of a number of polyhydroxy compounds, viz. Rochelle salt, sucrose, glycerol, mannitol, dulcitol, and triethanolamine, towards cuprammonium hydroxide were studied by the following methods— (*a*) determining the increase in the solubility of copper hydroxide in ammonia soln. brought about by the addition of the polyhydroxy cpd., (*b*) optical-rotation measurements, and (*c*) spectrophotometric measurements (when the cuprammonium ion reacts with a polyhydroxy cpd. the average number of ammonia molecules co-ordinated per Cu atom (degree of ammination) is found to increase, with a resulting change in the molar absorption coefficient of the soln.). Results obtained by the three methods agreed. The extent of the interaction between the polyhydroxy cpd. and cuprammonium hydroxide increases with the concn. of ammonia in all cases. This is attributed to the consequent increase in the concn. of hydroxyl ions and in the degree of ammination of the copper. The simpler polyhydroxy compounds react at low concentrations of ammonia, but cellulose and its derivatives are practically without reaction when the ammonia concn. is $< 3$ moles/litre.
A. E. S.

**Solubility and Structure of Cellulose Acetates.** F. Howlett and A. R. Urquhart. *Chem. and Ind.*, 82–87 (3rd Feb. 1951).

Recent research on cellulose acetate is reviewed, with 43 references. Attention is paid to solubility, crystallinity, the effects of distribution, amounts, and types of substituents, and effects of auxiliary combined groups and chain lengths. Stress is laid on the inadequacy of ordinary analytical data in specifying exactly the composition and properties of materials— thus it is possible to have two apparently entirely different acetates which are identical analytically. Greater care in nomenclature is urged.
J. W. B.

**Action of Light on Chemical Fibres.** A. Sippel. *Melliand Textilber.*, **32**, 205–209 (March 1951).

A review of the literature dealing with optical phenomena associated with fibres, mainly synthetic or regenerated. Special reference is made to the decomposition process taking place when fibres are exposed to daylight and artificial sources, discussing the laws involved, the decomposition process, and products which accelerate and retard decomposition respectively.
B. K.

**Manufacture of Algal Chemicals. I— Production of Alginates from Brown Marine Algæ.** L. A. Bashford, R. S. Thomas, and F. N. Woodward. *J.S.C.I.*, **69**, 337–343 (Nov. 1950).

A semi-plant-scale process is described for the production of calcium alginate from *Laminaria digitata* and *Ascophyllum nodosum*. By careful choice of operating conditions it is possible to obtain a product of reasonably constant composition and viscosity.
H. K.

**Extraction of Alginates from Canadian Seaweeds.** R. C. Rose. *Canadian J. Technol.*, **29**, 19–28 (Jan. 1951).

Canadian seaweeds have been evaluated as sources of alginate and rated in the following order of decreasing suitability— *Laminaria digitata, Nereocystis luetkeana, Macrocystis integrifolia, Ascophyllum nodosum, Fucus vesiculosus*. The first three species were equal to seaweeds that are used commercially in Britain and U.S.A. The extraction of alginate from seaweed was studied. Yield and quality were sensitive to the method of extraction and purification. The method adopted comprised pretreating the dried seaweed for 30 min. in lime water at 60°C. and for 30 min. in cold 0·2 N. sulphuric acid, then digesting the residue in 3% sodium carbonate for 2 hr. at 20°C. to dissolve the alginate, diluting, stirring for $>2$ hr., and filtering. The solution was bleached with sodium hypochlorite, and the alginate was precipitated with calcium chloride. The lime pretreatment facilitated bleaching and improved the viscosity and clarity of the alginate.
W. K. R.

**Histological Structure of the Scale Covering of Animal Fibres.** H. Haselmann and H. Zahn. *Melliand Textilber.*, **32**, 1–6 (Jan. 1951).

An examination of the scale structure of wool fibres by electron and phase-contrast microscopy has revealed longitudinal markings which suggest that both scales and epithelial cells possess a fibrillary structure. A portion of the scale covering together with its associated intermediate membrances was obtained by treatment firstly with formamide and then with pancreatin solution, and showed a similar parallel structure oriented along the fibre axis.
H. K.

**Technical Possibilities for a Regenerated Silk.** H. Wakeham, R. K. Toner, H. R. Jolley, and H. S. Taylor. *Text. Research J.*, **21**, 110–115 (Feb. 1951).

The technical possibilities for a regenerated silk and the essential requirements of the product are considered. Recent work on the properties of silk solutions is reviewed. From the structural point of view it should be possible to make a good textile fibre from silk fibroin. Work on aqueous solutions for the regeneration of silk fibroin has demonstrated that no significant difference exists between the composition of silk in solution and that which is precipitated, but there may be a difference in the type of aggregation. Two samples of regenerated silk have been examined and had tenacities much lower than natural silk. Their load–extension curves were also very different in shape from that of the natural product, whilst the fibres did not have the silky handle and appearance characteristic of silk. It seems possible, however, that the problems involved could be solved and an acceptable fibre produced if the economics justified it.
P. C.

**Absorption of Strong and Weak Acids by Casein and Zein Fibres.** E. Elöd and H. G. Fröhlich. *Melliand Textilber.*, **32**, 40–43 (Jan. 1951).

The absorption of hydrochloric, chloroacetic, formic, and acetic acids by casein and zein fibres has been studied under various conditions of pH. The casein fibre was treated both by formaldehyde and by acetylation. The absorption of all three fibres increases with a decrease in pH, the effect being particularly marked at $pH < 1$. Experiments show that the effect does not depend upon the separation of formaldehyde or acetic acid residues.
H. K.

**Certain Physico-mechanical Properties of Synthetic Polyamide Fibres.** V. V. Linde and A. A. Rogovina. *Tekstil. Prom.*, **10**, 22–25 (Dec. 1950).

An investigation was made into certain properties of the polyamide fibres, Perlon and Capron, and also of viscose rayon, for comparison purposes. The results are presented in tables and graphs. Firstly, measurements were made of the variation in length of unloaded Capron yarn on immersing it in water for a period, and then allowing it to come into equilibrium with a normal conditioned atmosphere; the temp. of the water was varied. The final result, after drying is always a shrinkage, but immediately on immersion there is an extension, which is followed by shortening of the fibres, so that at high temperatures a shrinkage is shown, even before drying. If immersion in water is replaced by a dry treatment at the same temp., only shrinkage is observed. The significance of these results in relation to setting is discussed. A second series of

experiments concerns the tensile properties of the fibres. The polyamide yarns were treated without tension in water at 95°C. for 2 hr., and the effect on the count, breaking load, and extension at break was determined. The effect of dry heat was measured for temperatures up to 150°C. The breaking load, as measured at the temp. of treatment, always falls (by about 70% at 150°C.), but, except when the period of heating is very long (e.g. > 30 min. at 150°C.), it recovers its initial value rapidly and completely when the yarn is re-exposed to normal conditions (owing to shrinkage, however, the strength expressed as tenacity is reduced). The results are the same whether the test is done in air or in nitrogen. Now it has been reported that, in the case of nylon, the fibre suffers a greater loss in strength when heated in air than when heated in nitrogen; it is suggested that the difference observed might have been due to tension effects, for it is found that if the heated polyamide yarn is maintained at constant length between clamps, so that relaxation cannot occur, there is a considerable, irreversible fall (by 60% in a 30-min. treatment at 150°C.) in the breaking load, possibly due to the occurrence of a crystallisation process. Thirdly, measurements were made of the change in length of the yarn with time under constant load. The effect is very small for the polyamide fibres. A. E. S.

**Polyester Fibres— Terylene, Fiber V [Dacron].** P.-A. Koch. *Textil-Rund.*, **6**, 107–110 (March 1951).

Data on the history, method of manufacture, properties, and applications of polyester fibre are given in tabular form. F. A.

**PCU Polyvinyl Chloride Fibre.** F. Liesenberg. *Melliand Textilber.*, **32**, 169–172 (March 1951).

The physical properties of PCU Fibre are given in tabular form in comparison with Saran, Velon, and various brands of PC Fibre and Vinyon. The manufacture, physical properties, and structure, illustrated by photomicrographs and X-ray diagrams of polyvinyl fibres, especially PCU Fibre and PC Fibres A and B, are described, as well as their mechanical and chemical properties and field of application. B. K.

PATENTS

**Continuous Spinning Process for Viscose Rayon.** La Seda de Barcelona S.A. *B.P.* 651,980.

Viscose threads, freshly spun from the normal acid baths, are led in a frequently ascending and descending path, so that the thread, whilst free from contact with any guide, is wetted with the usual aftertreatment liquids necessary for coagulation and purification. W. G. C.

**High-tenacity Viscose Rayon.** Comptoir des Textiles Artificiels. *B.P.* 650,896.

Viscose rayon having dry tenacity > 4·8 g./denier and elongation at break > 8% is made by extruding into dil. $H_2SO_4$ at 10–30°c. a viscose prepared from cellulose of which < 25% had a degree of polymerisation (D.P.) below 500 and < 4% had a D.P. below 250, and the mean D.P. of the alkali cellulose after ripening was 450; the degree of xanthation $\gamma$ of the viscose was 40–50 and the concn. of $H_2SO_4$ in the bath was 57·5–73 defined by the formula $1{\cdot}26\,\gamma + 8 \pm 3$. The wet filaments are stretched by 150–280%. W. G. C.

**Coloured Polyethylene Terephthalate Fibres.** I.C.I. Ltd., E. Waters, and L. Wood. *B.P.* 651,694.

An organic colouring matter is added to the polymer before extrusion. The resulting fibres are more uniformly coloured and, if desired, more intensely coloured than those obtainable by hitherto known processes. C. O. C.

**Polymerising Acrylonitrile to White Polymers in Dimethylformamide.** du Pont and J. C. Richards. *U.S.P.* 2,528,710.

Dimethylformamide is a solvent for both the monomeric and polymeric acrylonitrile. The monomer may be polymerised in solution by using 0·1–5·0% (on the weight of the acrylonitrile) of a boron trifluoride–dimethylformamide complex as catalyst. C. O. C.

**Solutions of Acrylonitrile Polymers.** American Viscose Corpn. *B.P.* 652,012.

Mixtures of nitromethane (20–90 vol.) with formic acid, formamide, dichloroacetic acid, cyanoacetic acid, or $\alpha$-hydroxy-$\beta$-trichloropropionitrile (80–10) exert no swelling effect on acrylonitrile polymers at ordinary temperatures, but dissolve them completely to colourless, commercially acceptable solutions at not > 80°c. C. O. C.

**Wet Spinning of Acrylonitrile Polymers.** du Pont and W. A. Hare. *U.S.P.* 2,530,962.

Acrylonitrile polymers or copolymers are extruded in an aqueous bath containing not < 12% by weight of a thiosulphate. Yarns of high tenacity and elongation, lustrous and free from voids, are obtained. C. O. C.

***NN*-Dimethylacetamide as Solvent for Polyvinylidene Chloride and Polyacrylonitrile.** Industrial Rayon Corpn. and G. F. D'Alelio. *U.S.P.* 2,531,406, *U.S.P.* 2,531,407.

*NN*-Dimethylacetamide free from acetic acid is an excellent solvent for polymers containing 50% or more of vinylidene chloride or polyacrylonitrile. C. O. C.

**Interpolymers of Acrylonitrile and Itaconic Acid.** Industrial Rayon Corpn. and G. F. D'Alelio. *U.S.P.* 2,531,408.

Copolymers of acrylonitrile and 1–5% of itaconic acid not only have better dyeing properties than polyacrylonitrile but have better resistance to heat and shrinkage and better tensile strength. C. O. C.

**Interpolymers of Acrylonitrile and Fumarodinitrile.** Industrial Rayon Corpn. and G. F. D'Alelio. *U.S.P.* 2,531,409.

Copolymers of not < 40% by weight of acrylonitrile, not < 1% of fumarodinitrile, and not < 1% of methyl $\beta$-cyanoacrylate, $\beta$-cyanoacrylamide, itaconamide, acrylic acid, methacrylic acid, methacrylonitrile, vinyl chloride, vinylidene chloride, vinyl chloroacetate, styrene, mono- or di-chlorostyrene, or itaconic acid yield fibres of improved tensile strength and resistance to shrinkage and heat. C. O. C.

**Copolymers of Acrylonitrile and Itaconamide.** Industrial Rayon Corpn. and G. F. D'Alelio. *U.S.P.* 2,531,410.

Copolymers of 29–99% of acrylonitrile and 71–1% of itaconamide have good heat resistance and tensile strength and improved dyeing properties. C. O. C.

**Copolymers of Epichlorohydrin and Aromatic Hydroxy Compounds.** Courtaulds Ltd., A. S. Carpenter, E. R. Wallegrove, and F. Reeder. *B.P.* 652,024.

Fibre-forming polymers are obtained by heating an equimolecular mixture of epichlorohydrin and an aromatic dihydroxy compound in which the hydroxyl groups are phenolic and the C atoms linked to the hydroxyl groups are separated by at least 1 C atom, e.g. quinol, and a quantity of caustic alkali such that its molar ratio to the dihydroxy compound is 1·0–1·1.

*B.P.* 652,030.

The dihydroxy compound is replaced by *m*- or *p*-hydroxybenzoic acid. W. G. C.

**Unwoven Fabric simulating Woven Fabric.** H. Wurzburger. *B.P.* 652,271.

The fabric comprises warp filaments and pairs of weft filaments, the latter being made of synthetic organic plastic material formed about the warp filaments by moulding *in situ*, the weft filaments of each pair being contiguous between each of the warp filaments. Each pair of weft filaments, while originally separate, become welded together during finishing, so that the crossing points with the warps are permanently spaced from one another by intermediate welded portions of each pair of weft filaments. Stiffness is avoided by forming helical grooves, at least one in each pair of weft filaments. C. O. C.

**Reactions of Formaldehyde in Hardening and Stabilisation of Artificial Protein Fibres.** H. G. Fröhlich. (X, p. 290.)

**Nature of the Interaction of Chromium Complexes with the Principal Groups of the Protein Molecule.** I. P. Strakhov. (XII, p. 292.)

## VII— DESIZING; SCOURING; CARBONISING; BLEACHING

**Relations between the Speed of Wetting and Rate of Change of Surface Tension of Solutions of Wetting Agents.** H. Lange. *Kolloid-Z.*, 121, 130–134 (March 1951).

It was shown by Bartholomé and Schäfer (*Melliand Textilber.*, 31, 487 (1950)) that there is a relation between the speed of wetting of a textile by a solution of surface-active agent and the rate of decrease of surface tension at a freshly formed surface of the same solution. The rate of decrease of surface tension was given by the equation—

$$\gamma_{H_2O} - \gamma = \frac{a}{b/\sqrt{t} + 1}$$

where $a$ and $b$ are constants which can be derived theoretically. If, now, $\gamma$ is plotted against $\sqrt{t}$, then the initial rate of decrease of $\gamma$, i.e. $-(d\gamma/d\sqrt{t})_{t=0}$ is equal to $a/b$. Measurements on a series of solutions of commercial wetting agents show that wetting time decreases as the quotient $a/b$ increases. It is also calculated from the above equation that there is a linear relation between the logarithms of the time of wetting and of the concentration. That there is such a relation has been known empirically for some time. F. A.

**Use of Sulphites in the Kiering of Cotton Fabrics.** M. G. Kachurin, A. E. Orekhova, E. E. Tsirkel, and A. V. Koroleva. *Tekstil. Prom.*, 11, 35 (Feb. 1951).

The presence of sulphites in the kier assists in the removal of motes. By the adoption of a modified caustic-soda kier liquor containing sodium sulphite, the time required for boiling a heavy fabric of poor-quality cotton was reduced from 10 to 5 hr. The normal kier liquor contained caustic soda alone at a concn. of 6 g./litre; the modified liquor contained, per litre— 10–12 g. of caustic soda, 10 g. of sodium sulphite, and 2 g. of a soap. After bleaching, fabric boiled in this soln. was whiter, more absorbent, and of lower cuprammonium fluidity than fabric from the normal boil. The new kiering procedure was compared with other modifications of the caustic-soda boil that are in general use, viz. with the addition of chloramine T, of sodium hypochlorite, or of resin soap. The all-round characteristics of fabric from the new boil were superior in every case. A. E. S.

**Influence of Bleaching on the Mean Degree of Polymerisation of Cellulose Fibres.** K. Zwicky. *Textil-Rund.*, 6, 1–11 (Jan.), 53–66 (Feb. 1951).

Methods for measuring the degree of polymerisation (D.P.) of cellulose are reviewed. In the present investigation D.P. has been calculated from measurements of the fluidity of cellulose in cuprammonium hydroxide solution using a modification of the formula proposed by Battista (*Ind. Eng. Chem., Anal. Ed.*, 16, 351 (1944)). The method of measuring the fluidity is described in detail. Values of D.P. determined in this way were found to agree well with those calculated from measurements of the viscosity of solutions of the cellulose after nitration and dissolution in *n*-butyl acetate. Cotton was bleached using sodium hypochlorite, sodium chlorite, hydrogen peroxide, and potassium permanganate under a variety of conditions, and the decrease in D.P. determined. The results are finally expressed as the number of breaks per 10,000 glucose residues, this quantity being given by the formula

$$\frac{100 \times \%\ \text{Decrease in D.P.}}{\text{Final D.P.}}$$

The degradation on bleaching in alkaline solutions of sodium hypochlorite increased with decrease in pH. With hydrogen peroxide the extent of degradation depended on the concentration, pH, and temperature. Acid solutions of sodium chlorite caused only slight degradation, but acid solutions of potassium permanganate a large amount of degradation. Additional experiments were made to compare the influence of bleaching on cotton and bright and matt viscose rayon. In general the extent of attack on bright viscose and cotton was of the same order, but with all the above bleaching agents the matt rayon suffered appreciably more degradation. It was also found that repeated washing with sodium perborate causes a large decrease in the D.P. of cotton. F. A.

**Evolution of Bleaching.** M. J. Mouton. *Teintex*, 16, 109–127 (March 1951).

Review of American and French systems of continuous bleaching. The history, technology, and economics of the process are discussed. F. A.

**Modification of Cellulose in Chlorine Bleaching.** H. Rath. *Melliand Textilber.*, 31, 832–835 (Dec. 1950).

A study has been made of the changes in the functional groups of the cellulose molecule produced by chlorine bleaching. The "reversible Methylene Blue" method has been used for the determination of carboxyl content. It is probable that viscose rayon possesses a greater affinity for basic dyes than cuprammonium rayon on account of its higher carboxyl content. In contrast to this, viscose possesses a lower affinity for direct dyes. A reduction in the degree of polymerisation of the cellulose is shown to be related to an increase in carbonyl groups. H. K.

**Bleaching of Vegetable Fibres with Sodium Chlorite.** H. Baier. *Melliand Textilber.*, 32, 141–146 (Feb. 1951).

Various methods of activating sodium chlorite for bleaching purposes are studied, e.g. by means of acid, hypochlorite, chlorine, persulphate, and formaldehyde. The chlorite bleach activated by acid is superior to the use of hypochlorite as activator with respect to bleaching effect, breakdown, and gentle treatment of the fibre, and is the method employed in practice. The chemistry of the use of formaldehyde as activator is described. B. K.

PATENTS

**Activating Chlorite Solutions for Bleaching Cellulosic Materials.** Solvay & Cie. *B.P.* 651,405.

A hydrolysable chlorinated organic compound, e.g. trichloroethylene, sensitive to the oxidising action of the chlorite solution so as to form an acid-reacting compound, is added to the chlorite solution so as to lower its pH and thus activate it.

*B.P.* 651,450.

Acetone is used as the activating agent, the initial pH of the chlorite solution being comparatively low, e.g. pH 7, and/or the concentration of the acetone should be comparatively high. C. O. C.

**Degumming and Bleaching Ramie.** S. J. F. Jensen. *U.S.P.* 2,530,244.

China grass is soaked for at least several hours in a minor fraction of 1% of an aq. aluminium salt. It is then boiled in 1% caustic soda for 2 hr. and stood in the liquor for several hours. The ramie is then boiled in a minor fraction of 1% HCl for 2 hr., immersed in a solution of an oxidising salt for some hours, then boiled for some hours, and again stood in the liquor for some hours. It is then given a second alkali and a second acid treatment as above. Finally it is boiled for several hours in an oxidising salt solution much weaker than the one first used, rinsed, and dried. A fine, bleached ramie is produced which can be made up into fabrics of high quality. C. O. C.

## VIII— DYEING

**Native Maori Dyeing Methods in New Zealand.** W. G. Fischel. *Ciba Review*, (84), 3057–3059 (Feb. 1951).

A description of methods employed by the Maoris for dyeing flax using vegetable extracts obtained from barks of native trees and bushes, resulting in the production of blacks, reds, yellows, and blues. B. K.

**"Physical Condensation" of Dyeings.** R. Haller. *Melliand Textilber.*, 32, 50–52 (Jan. 1951).

An examination of levelly dyed cellulosic fibres placed in water under pressure shows that there is a tendency for the dye to crystallise in aggregates, particularly in the lumen in the case of the cotton fibre. The effect is particularly marked with indigo-dyed cotton. H. K.

**Influence of pH in the Application of Direct Cotton Dyes to Cotton and Wool–Cotton Unions.** C. Faure and J. Coupat. *Teintex*, 16, 3–11 (Jan. 1951).

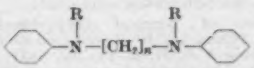
The degree of exhaustion of several direct cotton dyes has been followed and the results are given graphically to demonstrate the effect of variations in pH and temp. The application of this work in the dyeing of cotton and other cellulosic fibres and also in the dyeing of wool–cotton unions is shown. B. K.

**Fast Dyeings with Vat Dyes on Acetate Rayon.** M. Bräuer. *Textil-Praxis*, **6**, 201–204 (March 1951).

Vat dyes can be applied to acetate rayon by the use of a swelling agent such as ethyl alcohol or tetrahydrofuran. The results are dependent on the type and concn. of swelling agent, temp. of dyebath, concn. of NaOH used, time of dyeing, liquor ratio, and other additions to the dyebath. The dyeings obtained correspond in general fastness properties to those of the same dyes on viscose rayon. No degradation of the acetate rayon is shown. B. K.

**Improvement in Fastness to Gas-fume Fading of Dyes for Acetate Rayon.** F. H. Smith. *Melliand Textilber.*, **32**, 148 (Feb. 1951).

A product of the following general formula is used to improve the fastness to gas-fume fading of dyes for acetate rayon—



($n$ = 2–6; R = H, $CH_3$, $C_2H_5$, or $C_2H_4{\cdot}OH$). A stable aqueous emulsion is prepared in paste form containing 30–50% of the above cpd., 1–5% polyvinyl alcohol, and 2–15% of an organic softener. B. K.

**Developments in Continuous Dyeing Processes for Wool.** G. Nitschke. *Melliand Textilber.*, **31**, 843–847 (Dec. 1950).

A review is given of the methods at present available and some of the difficulties to be overcome in the continuous dyeing of wool. H. K.

**[Thermal] Properties of Dyeings on Wool Fabrics.** A. M. Serebryakov. *Tekstil. Prom.*, **10**, 37–38 (Dec. 1950).

The effect of dyeing on the thermal properties of a wool fabric is assessed from the density of a photograph of the fabric taken with infra-red radiation. The results obtained on various dyeings are listed. A. E. S.

PATENTS

**Vat Dyeing of Cellulose Acetate.** Celanese Corpn. of America, G. W. Seymour, G. C. Ward, and R. L. Hunter. *U.S.P.* 2,528,614.

The material is padded with an aqueous suspension of an indigoid vat dye, dried, repadded with aqueous alkaline sodium formaldehyde-sulphoxylate and a hydroxy-substituted aliphatic amine, steamed while wet to reduce the dye, and finally treated in a suitable aqueous oxidising bath. The dyed material is fast to rubbing and shows no trace of saponification. C. O. C.

**Dyed Cellulose Ether Preparations for Application to Textiles.** Dan River Mills Inc. *B.P.* 651,283.

A pure colloidal solution of a previously dyed fibrous cellulose ether dissolved in aqueous caustic alkali is used for colouring vegetable fibres by impregnating them with the solution and then treating with a coagulant. Any type of dye may be used to colour the cellulose ether, e.g. acid dyes for sighting. In the case of dyes substantive to cellulose, the dyeings produced by this method are faster to light than those dyed by conventional methods. C. O. C.

**Colouring of Polymerisation Resins in the Finely Dispersed State, and the Selective Absorption of Dyes by Synthetic Resins.** A. B. Davankov, V. P. Perepelkin, and E. A. Sokolova. (XIII, p. 292.)

## IX— PRINTING

**Use of Sulphamic Acids in the Preparation of Colouring Matters—Oxidation Blacks applied from Neutral or Alkaline Media.** R. Lantz. *Teintex*, **16**, 139 (March 1951).

The main difficulties in the application of oxidation dyes are overcome by transforming the amine into a sulphamic acid. Neutral or alkaline printing pastes can then be prepared which are stable until subjected to acid steaming, and do not cause tendering of the fibre. Solanile Black is an example of this new type of dye; it can be applied together with Naphtazogens, Solasol, and Chromine dyes. F. A.

**Preparation of Stable Diazo Printing Pastes.** Anon. *Tekstil. Prom.*, **10**, 49 (Dec. 1950).

According to the work of P. G. Shagin, diazotised Azoamin Scarlet Zh (Fast Scarlet G Base) yields a more stable printing paste when neutralised with chalk instead of with sodium acetate. A. E. S.

**Photographic Printing of Fabrics.** R. Delattre. *Teintex*, **16**, 129–137 (March 1951).

Photorapide (Fran) dyes consist of mixtures of a diazosulphonate and coupling component which couple under the action of light. It was first intended that these dyes should be applied in the conventional manner and then developed by irradiation rather than by steaming, but the process did not prove popular. Photographic printing processes have now been developed in which fabric padded with a Photorapide dye is exposed to intense illumination behind a photographic negative or a stencil. There are no decomposition products to discolour the background, but the coupling component may be difficult to eliminate. In the latest processes, however, this coupling component is not removed but is used to produce a ground colour. This can be done by aftertreatment in a bath containing a diazo compound, when coupling takes place in those regions which have not been subject to irradiation. Alternatively the Photorapide dye may be mixed with a diazoimino compound or nitrosoamine, and then, after photographic printing, the ground colour is developed by the usual steaming methods. Reference is also made to Belgian and American methods of photographic printing, based on the diazotype process, in which a diazo compound is destroyed locally by the action of light. In the Belgian process development is effected by aftertreatment in a bath containing coupling components, but in the American process the coupling component accompanies the diazo compound and the fabric is aftertreated in a chamber containing ammonia vapour. F. A.

PATENTS

**Printing and Embossing of Paper, Fabrics, or other Webs.** C. D. Bennett. *B.P.* 651,310.

The web is fed to a spot where an impression is made on a flat stationary area of the web by a plane printing or embossing surface having a movement synchronised with the web feed and directed normal to the flat area of the web. A wallpaper-printing machine based on this principle is described. C. O. C.

**Printing by means of Dye Carriers insoluble in Water.** C. Bener. *B.P.* 651,324.

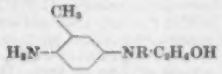
In printing by the process described in *B.P.* 589,020 (*J.S.D.C.*, **64**, 51 (1948)), if a linseed-oil varnish, if desired together with a printing oil, is used as the dye carrier, then the necessary modification of the carrier is obtained by treating the printed material with moist steam until the carrier is rendered at least in part water-penetrable, so that the dye can penetrate to the fibres. C. O. C.

**Photographic Printing with Dyes on Cloth, Leather, Paper, Plastics, Furs, etc.** L. R. Stewart. *U.S.P.* 2,531,086.

The material is treated with a water-soluble dye which becomes insoluble in water upon being exposed to light, e.g. an ester of a leuco vat dye, then exposed to light through a photographic negative, and finally washed to remove the dye which has not been insolubilised. Suitable machinery is described. C. O. C.

**Diazotype Composition containing 2-Diazo-5-*N*-hydroxyethylaminotoluenes.** General Aniline & Film Corpn., W. H. von Glahn, and L. N. Stanley. *U.S.P.* 2,529,464.

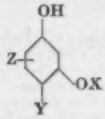
Diazo derivatives of compounds of formula—



(R = H, $CH_3$, $C_2H_5$, or $C_2H_4OH$), used as the light-sensitive component in diazotype compositions, give good stability to precoupling. C. O. C.

**Diazotype Material.** General Aniline & Film Corpn., S. C. Slifkin, and H. C. Unkauf. *U.S.P.* 2,532,126.

Use of a *p*-diazo derivative of an *N*-alkyl- or *N*-hydroxyalkyl-*m*-alkyl-, -*m*-alkoxy-, -*m*-hydroxyalkyl-, or -*m*-carboxyaniline in combination with a coupler of formula—




(X = H, $[CH_2]_n$·COOH, Alk, or hydroxyalkyl; Y = H, $SO_3H$, or a salt thereof; $n$ = 1–4; Z = H or a water-solubilising group obtained by the Mannich reaction; when X = H then Y or Z is other than H) results in azo images of improved opacity. C. O. C.

**Diazotypes comprising Amine Salts of Sulpho-containing Azo Components.** General Aniline & Film Corpn., W. H. von Glahn, L. N. Stanley, and M. A. Hand. *U.S.P.* 2,531,485.

Azo components containing sulphonic acid groups can be made wash-fast by treating them with amines either before the diazotype coating is formed or preferably by adding an amine to the coating. C. O. C.

**Diazotype Printing Material.** General Aniline & Film Corpn. and H. C. Unkauf. *B.P.* 651,625.

Films of water-repellent vinyl polymers or copolymers are rapidly and uniformly penetrated by solutions of diazotype sensitising components in a non-aqueous mixture of low-boiling ketones and high-boiling γ-lactones of 4–6 C. C. O. C.

**Multicolour Cinematograph Films.** P. Cuvier. *B.P.* 651,976.

**Dyed Cellulose Ether Preparations for Application to Textiles.** Dan River Mills Inc. (VIII, p. 289.)

## X—SIZING AND FINISHING

**Rate of Drying of Fabrics.** L. Fourt, A. M. Sookne, D. Frishman, and M. Harris. *Text. Research J.*, **21**, 26–33 (Jan. 1951).

In studies of the drying of fabrics exposed to air of low velocity, the major portion of the time required for drying was found to be occupied by the removal of liquid water. Drying rates for different fabrics when expressed as weight of water lost per unit surface area are nearly uniform for fabrics up to 1 cm. thick. The factor governing the rate of drying is the thickness of the relatively still air layer near the fabric surface, which in these experiments corresponded to 2·4 mm. of still air. The only large difference was noted for a fabric with a very high and open nap, in which the surface hairs appear to increase the thickness of the insulating layer, which is not compensated for by their being wet by capillarity. P. C.

**Economic Drying.** F. Fourné. *Textil-Praxis*, **6**, 278–281 (April 1951).

A critical study of the economics of drying textiles, particularly rayon, including hot air, calender, vacuum, preheated steam, infra-red, and high-frequency drying methods. B. K.

**Glycosidic Methoxyl Groups in Methanolysed Cellulose.** R. E. Reeves, L. W. Mazzeno, Jr., and C. L. Hoffpauir. *Text. Research J.*, **21**, 78–81 (Feb. 1951).

Acid-labile methoxyl groups in methanolysed cellulose are linked in glycosidic combination rather than in an acetal structure. The rate of removal of methoxyl groups from methanolysed cellulose on acid hydrolysis is roughly comparable to the rate of hydrolysis of methyl glucopyranosides. P. C.

**Reaction of 1:3-Difluoro-4:6-dinitrobenzene with Fibrous Proteins and Amino Acids—I.** H. Zahn. *Kolloid-Z.*, **121**, 39–45 (Feb. 1951).

Reactions of fluorodinitrobenzene (D.N.F.) and difluorodinitrobenzene (D.N.D.F.) with wool and silk respectively have been investigated in aqueous alcoholic solutions at pH 7 and 20–40°c. and in amounts of 4–50% on the weight of the fibre for periods of 2 hr.–8 days. The reaction of keratin fibre with D.N.F. causes a decrease in contraction in phenol, solubility in acids, and acid-combining power; D.N.D.F. leads to more marked effects, and reduces especially the alkali solubility. Silk treated with D.N.D.F. is less soluble in acids, copper ethylenediamine, and lithium bromide than either D.N.F.-treated or untreated silk. This stabilisation is ascribed to the formation of primary valency bridges between the micelles of the fibre proteins and the reagents. There are 24 references. H. H. H.

**Reaction of Formaldehyde with Cotton.** C. F. Goldthwait. *Text. Research J.*, **21**, 55–62 (Jan. 1951).

The work on the partial methylenation of cotton to improve its resistance to micro-organisms and to impart dye-resistivity is described. Although the treated cotton does not differ from ordinary cotton in appearance and textile character, it displays new properties such as decreased swelling capacity in water and other cellulose-swelling agents, even at relatively low formaldehyde contents (0·5–1·5%). The nature of the reactions and the products of the reaction are discussed, and the effects of water on the reaction system considered. P. C.

**Stabilisation of Neutral Hypochlorite-oxidised Cotton Fibre.** R. E. Reeves and J. R. Jung, Jr. *Text. Research J.*, **21**, 22–25 (Jan. 1951).

When cotton fibre which has previously been oxidised by neutral hypochlorite is treated with ethereal diazomethane, it becomes less susceptible to damage by alkali. The oxidised and treated fibre displays lower alkali solubility, lower cuprammonium fluidity, and greater strength after alkali exposure than does cotton that has been oxidised but not stabilised. Chlorous acid, which counteracts the latent damage in periodate-oxidised cotton, is not effective against the latent damage in hypochlorite-oxidised fibre. P. C.

**Reactions of Formaldehyde in Hardening and Stabilisation of Artificial Protein Fibres.** H. G. Fröhlich. *Melliand Textilber.*, **32**, 136–140 (Feb. 1951).

A description of the chemical reactions which may take place in hardening artificial protein fibres obtained from casein, ground-nut, soya, and maize protein. The primary amino, the amide, and possibly the peptide groups form the main points of attack by the formaldehyde. The methylene or oxymethylene bridges show varying stability, which can be improved by special methods of aftertreatment. The reaction possibilities of the carboxyl group with metallic salts are also considered. B. K.

**Heat Setting of Synthetic Fibres (Nylon and Perlon).** W. Hees. *Melliand Textilber.*, **32**, 215–221 (March 1951).

The chemical grouping and shrinkage properties in water and steam of various synthetic fibres are given. Heat-setting processes for nylon and Perlon employ the following— damp heat, hot steam, dry heat, and superheated steam. Commercial methods of setting nylon and Perlon hose both before and after dyeing, and the setting of nylon and Perlon piece goods, especially by American methods, are described in some detail. B. K.

**Action of Mitin on Moth Larvæ.** R. Lotmar. *Melliand Textilber.*, **32**, 68–70 (Jan. 1951).

The investigation shows that Mitin possesses a toxic effect on moth larvæ, and that the larvæ do not die from normal starvation. Although the wool is at first devoured by the larvæ and partly digested, the total effect is small, and semi-digested and undigested Mitin-treated fibres are found in the intestines and in the excreta. The damage produced on Mitin-treated wool is insignificant. H. K.

PATENTS

**Rendering Cellulosic Textiles more Water-absorbent.** Pacific Mills and D. M. Musser. *U.S.P.* 2,532,183.

Treating cellulosic textiles under pressure and at > 100°c. in an aqueous solution of an alkyl or alkali-metal alkyl phosphate (Alk of 4 or 5 C), e.g. tributyl or sodium butyl phosphate, at pH 11–13, enhances their rate of water absorption without weakening them. C. O. C.

**Reducing the Swelling Power of Regenerated Cellulose.** H. vom Hove. *B.P.* 651,305.

The material is treated in separate baths first with an organic base and acid and then with formaldehyde. This prevents precondensation of the base and formaldehyde before penetration into the fibres. The amount of organic base required is 5–7% of that required for the usual known processes. The treated material is not brittle, its fastness to washing is excellent, and dyeing is level and uniform over both surfaces. C. O. C.

**Preventing Discoloration of Mercury-carrotted Fur by Water containing Carbonates and/or Bicarbonates.** British Hat & Allied Feltmakers Research Assocn., T. Barr, and D. Haigh. *B.P.* 652,018.

Mercury-carrotted fur, or felt prepared from it, is boiled in water containing carbonates and/or bicarbonates to which has been added an ammonium salt of a strong acid, either in amount chemically equivalent to the carbonate–bicarbonate total, in which case the water is boiled for 10 min. before entering the felt, or in excess of the carbonate–bicarbonate total, in which case the felt is put straight in. In one example, to 100,000 parts of a natural water of 13·6° (French) total hardness, 8·8° being temporary, is added ammonium chloride (20 parts). After boiling for 10 min., a felt hood from mercury-carrotted fur is entered and boiled for 15 min. No discoloration is suffered by the hood, compared with the yellowish-brown stains which develop with untreated spring water. J. W. B.

**Water-repellent Textiles.** Ellis-Foster Co., Montclair Research Corpn., and J. B. Rust. *U.S.P.* 2,528,554.

Treatment with a neutral-reacting organosilicon compound followed by curing yields a water-repellent finish fast to washing and dry-cleaning without any loss in tensile strength or resistance to wear. Preferably 1–20% of an alkylalkoxysilicon or an alkylsilyl ester, e.g. ethylamyloxysilicon or ethylsilyl acetate, is applied to the textile and cured at 120–180°c. C. O. C.

**Waterproofing Cellulosic Materials.** National Lead Co. *B.P.* 652,186.

Cellulosic materials are rendered water-repellent fast to washing and dry cleaning by impregnating them with an aqueous solution of a double carbonate of zirconium and a water-soluble soap, and then heating the impregnated material so as to cause precipitation of a zirconyl monofatty acid compound upon it. C. O. C.

**Stiffened Collars, etc.** L. Kanitz. *B.P.* 651,256.

An unstiffened folding line is obtained on articles produced by fusing together plies of fabric by printing the thermoplastic adhesive used on to the lining or the outer fabric. C. O. C.

**Directionally Stiffened Fabrics.** Kendall Co. *B.P.* 651,983.

Fabrics stiffer in the direction of the warp than in that of the weft or *vice versa* are produced by having in the warp or weft a substantial proportion of cellulosic threads reactive to a gelatinising or fusing agent, the weft or warp being wholly of non-reactive threads, and treating with a gelatinising or fusing agent. By arranging the reactive threads so that gelatinising or fusing does not cause the aggregate of the twists of the threads to tend to change, the tendency of the fabric to curl is minimised. C. O. C.

**Composite Ribbons.** Courtaulds Ltd., C. Ford, and F. Fothergill. *B.P.* 652,005.

Composite ribbons of substantially uniform thickness are made by forming a bundle of parallel untwisted continuous filaments of a synthetic high-polymeric material, e.g. viscose, into a flat tape, and bonding the filaments together, while maintaining the parallel untwisted form, with a liquid bonding agent, e.g. plasticised cellulose acetate in acetone, which is then solidified. J. W. B.

**Textiles made Rotproof with Bis-4-hydroxy-3-chlorophenyldimethylmethane.** B. F. Goodrich Co., W. D. Stewart, and J. H. Standen. (III, p. 279.)

## XI—PAPER AND OTHER CELLULOSIC PRODUCTS

PATENTS

**Coloured Paper.** I.C.I. Ltd., J. A. Moyse, and G. G. Simpson. *B.P.* 651,139.

Paper coloured with water-soluble dyes which are non-substantive to cellulose is produced by applying the dyes during the manufacture of the paper, e.g. at the beater stage, in conjunction with a water-soluble condensation product obtainable by the interaction, if desired in the presence of modifying agents, of dicyandiamide, formaldehyde, and an ammonium salt. S. V. S.

**Coating Paper.** Minnesota & Ontario Paper Co., W. H. Barrett, and B. K. Asdell. *U.S.P.* 2,532,140.

A process is described which applies an even coating which requires no subsequent smoothing to avoid streaks on drying. C. O. C.

**Laminating Paper.** du Pont and R. H. Wiley. *U.S.P.* 2,526,787.

Paper that has been previously coated with a 1–10% aqueous solution of magnesium or zinc silicofluoride and then dried, when laminated using aqueous sodium silicate as the adhesive, yields a product which withstands immersion in water. C. O. C.

**Moistureproof Sheet or Film Wrapping Material.** British Cellophane Ltd. *B.P.* 650,948.

A moistureproof sheet or film wrapping material comprises a hydrophilic, hydroxylated organic polymer base sheet or film (e.g. regenerated cellulose) having a moisture-proofing coating thereon comprising a vinylidene chloride interpolymer (e.g. vinylidene chloride–acrylonitrile) and, disposed between the surface coating and the base sheet, an intermediate coating of hardened modified melamine–formaldehyde resin. The sheet may be impregnated with an aqueous solution of the resin-forming ingredients and afterwards heated, the ingredients may be in the partly condensed, water-soluble state, and the sheet may be impregnated in the gel state. The formed resin or its components (partly condensed if desired) may be applied in an organic solvent, and a cellulosic film-forming agent, e.g. cellulose nitrate, may be present. The hardened resin layer containing up to 90% of cellulose nitrate may range from 0·2 to 5·0 g./sq. metre of the coated sheet and the surface coating about 8 g./sq. metre. S. V. S.

**Vinylidene Chloride–Acrylonitrile Interpolymers—Coating Agents for Regenerated Cellulose.** British Cellophane Ltd. *B.P.* 651,155.

Interpolymers which give a moisture-resistant heat-sealing transparent coating when applied to regenerated cellulose film are made by polymerising a mixture of vinylidene chloride (90 parts) and acrylonitrile (10) in aqueous dispersion and in the presence of a catalyst until the yield of interpolymer is 55–70%. W. G. C.

**Vinylidene Chloride Interpolymers—Coating Agents for Regenerated Cellulose.** British Cellophane Ltd. *B.P.* 651,769.

Polymers suitable for the moistureproof coating of regenerated cellulose films are obtained by heating in the presence of a catalyst a mixture of 1–15% vinyl acetate or 2-hydroxyethyl acrylate, 5–15% acrylonitrile, and 70–94% vinylidene chloride; when vinyl acetate is used the acetate groups of the polymer are hydrolysed to hydroxyl groups. W. G. C.

**Regenerated Cellulose Films.** American Viscose Corpn. *B.P.* 650,876.

Regenerated cellulose film is impregnated with an acidic aqueous colloidal solution containing 0·5–20% by weight of a partly polymerised melamine–formaldehyde condensation product, the state of polymerisation of which is such that it is water-dilutable and colloidal in nature and has positively charged hydrophilic particles $< 1\ \mu$. in diameter. This is best done by reducing the moisture content of a gel-regenerated cellulose film, which has never been dried sufficiently to convert it from a wet gel state, to 25–65% before the impregnation, advancing the polymerisation of the condensation product until the resin cannot be dissolved out of the film by aqueous solutions, then impregnating the film with a plasticiser for the regenerated cellulose, and subsequently drying the plasticised film. The resin, which is still thermoplastic, is washed prior to the impregnation with the plasticiser, and is afterwards cured to a non-thermoplastic state before or after coating the dried film with a hydrophobic moistureproofing material which adheres more tenaciously to the treated film than it would to an untreated film. S. V. S.

**Plasticisers for Thermoplastic Derivatives of Cellulose.** British Celanese Ltd. *B.P.* 651,662.

Compounds of formula—

$$Cl\cdot[CH_2\cdot CH_2\cdot CH_2\cdot CH_2\cdot O]_n\cdot CO\cdot R\cdot X$$

($n = 1$ or 2; X = H or $-CO\cdot[O\cdot CH_2\cdot CH_2\cdot CH_2\cdot CH_2]_a\cdot Cl$; R = a bivalent hydrocarbon residue) are plasticisers for thermoplastic derivatives of cellulose, e.g. cellulose acetate. C. O. C.

**Coating Cellulose Propionate.** British Celanese Ltd. *B.P.* 651,855.

Articles of cellulose propionate are given a smooth adherent blush-resistant coating by applying a solution of cellulose nitrate in a mixture of a medium-boiling solvent, e.g. amyl acetate, an aliphatic alcohol containing < 5 C, e.g. butyl alcohol, and an aliphatic hydrocarbon or hydrocarbon fraction boiling below 150°C. W. G. C.

**Textile-Rubber Composites, Solvents and Cements.** F. T. Bowden. (XIII, this page.)

**Chlorinated Indane Derivatives—Plasticisers.** Standard Telephones & Cables Ltd. and A. J. Warner. (XIII, p. 293.)

## XII—LEATHER; FURS; OTHER PROTEIN MATERIALS

**Effect of Heat on the Structure and Properties of Proteins. I—Collagen.** A. L. Zaides. *Kolloid. Zhur.*, **12**, 347–351 (1950): *Chem. Abs.*, **45**, 889 (25th Jan. 1951).

Untreated collagen shows X-ray crystal spacings of 2·9 and 11–12 A. and a broad diffuse ring at 4·5 A. Heating to 135°C. causes no alteration, but after 8 hr. at 170°C. the 2·9 A. spacing disappears; it reappears (indistinctly) after 18 months' storage at room temperature. Similar changes occur in chrome leather. Untreated collagen takes up 10 and 40% $H_2O$ at R.H. 10 and 90% respectively; that heated at 170°C. absorbs about 5 and 30%. Absorption of water vapour by chrome leather is little affected by heating. Untreated collagen increases 64, 231, and 188% by weight in water, 0·1 N-HCl, and 0·1 N-NaOH respectively; the increases with heated collagen are 37, 54, and 90%. Tensile strength and total elongation are reduced by heating, e.g. from 1·57 to 1·43 kg./sq. mm. and from 51 to 8%. A hot-water extract of untreated collagen gels on cooling, but one of heated collagen does not. Acid-combining capacity is increased by heating. Apparently heating ruptures the main valence chain and produces new links between the chains. C. O. C.

**Composition of Skin Collagen and the Effect of Alkalis on Collagen.** J. H. Bowes. *Research*, **4**, 155–162 (April 1951).

A review of present knowledge; 35 references. C. O. C.

**Guide to the Literature on Collagen.** R. Borasky. *U.S. Bureau of Agr. and Ind. Chem.*, **AIC–278**, 135 pp. (1950): *Chem. Abs.*, **45**, 377 (10th Jan. 1951).

A classified bibliography of 1008 references, principally on collagen, but partly on gelatin, glue, leather, elastin, reticulin, connective tissue, proteins, etc. Author and subject indexes are given. C. O. C.

**Nature of the Interaction of Chromium Complexes with the Principal Groups of the Protein Molecule.** I. P. Strakhov. *J. Appl. Chem.* (*U.S.S.R.*), **24**, 142–147 (Feb. 1951).

Collagen, collagen in which the amino groups had been blocked by formaldehyde treatment, silk fibroin, and polycaprolactam fibre were chromed, each with three different basic chromium salts. No chromium was fixed by the polyamide, and it was concluded that the peptide groups of proteins play no part in the reaction with chrome complexes. Silk fibroin took up much less chromium than did collagen, and this was attributed to the smaller number of $NH_2$ and COOH groups in its side-chains. The behaviour of formalised collagen indicated that complex chromium compounds containing their chromium in the cation react with the COOH groups, whereas the anionic compounds react with the $NH_2$ groups. However, the collagen, after treatment with formaldehyde, was found to have a reduced uptake of *cationic* basic chromium sulphate, and it is considered that hydrolytic changes occurring during the tanning process lead to the breakdown of some of the cationic complex and to the formation of a complex chromium anion. The basic chloride does not show this behaviour. A. E. S.

PATENT

**Lubricated Leather containing an Aluminium Salt.** American Cyanamid Co., J. H. Stumpf, and W. O. Dawson. *B.P.* 651,866.

Leather containing an Al salt is treated with an aqueous fat-liquoring emulsion containing a cationic emulsifying agent in the presence of 1–10%, on the weight of the leather, of a water-soluble phthalate, which is preferably present in the leather before fat-liquoring but which may be present in the fat liquor. Better exhaustion of the fat-liquoring bath and more even distribution of the lubricant throughout the leather are obtained. C. O. C.

## XIII—RUBBER; RESINS; PLASTICS

**Antioxidant Capacity of Methyl Red for Raw Natural Rubber.** T. Hayashi. *J. Soc. Rubber Ind. Japan*, **21**, 162, 163 (1948): *Chem. Abs.*, **45**, 377 (10th Jan. 1951).

Viscosity measurements show that Methyl Red is a more effective antioxidant in presence or absence of light than either quinol or phenyl-β-naphthylamine. C. O. C.

**Synthetic Rubber [Review of Literature for 1949].** T. H. Messenger and R. W. Parris. *Annual Report on the Progress of Rubber Technology*, **23**, 18–28 (1949).

134 References. C. O. C.

**Compounding Ingredients [for Rubber—Literature for 1949].** J. Haworth. *Annual Report on the Progress of Rubber Technology*, **23**, 29–35 (1949).

Deals with carbon black, fillers, accelerators, and anti-oxidants. 56 references. C. O. C.

**Physical and Chemical Properties of Vulcanised Rubber.** L. Mullins. *Annual Report on the Progress of Rubber Technology*, **23**, 44–48 (1949).

Review of the literature for 1949; 49 references. C. O. C.

**Textile-Rubber Composites, Solvents and Cements.** F. T. Bowden. *Annual Report on the Progress of Rubber Technology*, **23**, 72–74 (1949).

A review of the literature for 1949. It is mostly concerned with adhesion between rubber and textiles; 11 references. C. O. C.

**[Pigments for] Coatings for Rubber Goods.** H. Hadert. *Farbe & Lack*, **56**, 447–449 (1950): *Chem. Abs.*, **45**, 878 (25th Jan. 1951).

Suitable pigments are good gas blacks (1·5–2·0%), $TiO_2$, Helio Fast Yellow, Helio Bordeaux, Paris Blue, and synthetic iron oxides; zinc white is unsuitable for use alone because of its poor hiding power. C. O. C.

**Optical Properties of Pigments as related to their Use in Rubber.** C. E. Barnett and H. C. Jones. *India Rubber World*, **123**, 45–50 (1950): *Chem. Abs.*, **45**, 2249 (10th March 1951).

A critical review (35 references) of the factors which govern the colours imparted by pigments to vulcanised rubber. The colour of the pigmented vulcanisate is governed by light absorption, value of *n*, the size, shape and dispersibility of the pigment particles, and the chemical reactivity of the pigment or of impurities contained in it. Absorption of light is the principal factor attributable to the rubber phase of the system, and is magnified by reaction between the rubber hydrocarbon and S during vulcanisation and by subsequent ageing of the rubber. Chemical reactions between various compounding ingredients or impurities in them may greatly change the absorption of light by the system, with the net result that a small proportion of impurities present may spoil the colour of a white or delicately coloured vulcanisate in spite of adherence to other compounding requirements. C. O. C.

**Colouring of Polymerisation Resins in the Finely Dispersed State, and the Selective Absorption of Dyes by Synthetic Resins.** A. B. Davankov, V. P. Perepelkin, and E. A. Sokolova. *J. Appl. Chem.* (*U.S.S.R.*), **24**, 95–101 (Jan. 1951).

Addition of a soln. of a basic dye to a fine aqueous dispersion of emulsion-polymerised methyl methacrylate leads to coagulation, a definite amount of dye, proportional to the acid number of the polymer, being necessary for coagulation to be complete. The acid number of the polymer increases with the proportion of oxidising agent (ammonium persulphate) used as initiator, and when the polymer is subjected to fractional precipitation to yield fractions of varying mol. wt., the acid number is

found to increase with mol. wt. The polymer–dye complex no longer exhibits all of the properties of the isolated dye. Thus, it may be dissolved in solvents in which the dye itself is almost insoluble, and the colour of the evenly dyed transparent mass that can be prepared from it is of very high fastness to light. Similar considerations hold for polystyrene, polyvinyl chloride, and copolymers of vinyl acetate with methyl methacrylate. A. E. S.

**Transarylation Reaction of Diarylalkanes.** V. V. Korshak and G. S. Kolesnikov. *Doklady Akad. Nauk S.S.S.R.*, **76**, 69–72 (1st Jan. 1951).

The transarylation reaction of 1:2-diphenylethane in presence of aluminium chloride, which has been described previously (cf. J.S.D.C., **67**, 48 (Jan. 1951)), has been extended to other diarylalkanes, viz. diphenylmethane, 1:1-diphenylethane, 1:3-diphenylpropane, 1:4-diphenylbutane, and 1:2-bis-5′:6′:7′:8′-tetrahydro-2′-naphthylethane. Benzene, or in the last case tetralin, was eliminated, and in every case a linear polycondensate, formed by *para*-substitution reactions, was obtained. In some cases a three-dimensional condensate, insoluble in benzene and infusible, was formed also; its formation is attributed to the occurrence of some *ortho*-substitution. Other side-reactions lead to the formation of some indane, in the condensation of 1:3-diphenylpropane, and some tetralin, in the condensation of 1:4-diphenylbutane. The destructive oxidation of the linear condensate from 1:2-diphenylethane yields terephthalic acid, and the condensate from 1:3-diphenylpropane yields a mixture of terephthalic acid and *p*-phenylenediacetic acid; this is in accord with the postulated structures of the products. There is some evidence that the linear condensates are not entirely free from side-chains. The mechanisms of the main and side reactions are discussed, and their bearing on some known reactions, involving condensation in presence of aluminium chloride, is considered. A. E. S.

PATENTS

**Stabilising Organo-substituted Polysiloxanes.** British Thomson-Houston Co. Ltd. *B.P.* 650,800.

An iron, cobalt, nickel, or copper salt of an organic acid is used. C. O. C.

**Hydroxymethyl Siloxanes and Thermally Stable Resins produced by treating them with Hydrocarbon Di*iso*cyanates.** Dow Corning Corpn. and J. L. Speier, *Jr.* *U.S.P.* 2,527,590.

Hard, tough resins resistant to solvents are obtained by treating a compound of formula—

$$HO\cdot CH_2\cdot[SiR_2\cdot O]_n\cdot SiR_2\cdot CH_2\cdot OH$$

(R = a hydrocarbon radical free from aliphatic unsaturation; $n$ = a whole number) with a di*iso*cyanate.

*U.S.P.* 2,527,591.

Hydroxymethyl siloxanes of the above formula are obtained by subjecting an organic ester of a primary alcohol substituted with an organosiloxane radical in the $\alpha$-position to alcoholysis. This converts the group linked to the Si atom and containing an ester linkage to a hydroxymethyl group on the Si atom. C. O. C.

**Accelerators for the Curing of Hydrocarbon-substituted Polysiloxane Resins.** British Thomson-Houston Co. Ltd. *B.P.* 650,993.

Organic quaternary ammonium bases or compounds of formula $R^1_4NOR^2$ ($R^1$ = hydrocarbon radicals which may be hydroxy-substituted; $R^2$ = H or acyl) are accelerators for the curing of liquid, soluble polysiloxane resinous compositions. They not only speed up curing but also enable it to be carried out at lower temperatures. C. O. C.

**Plastic Films.** M. A. Chavannes and G. T. Traut. *B.P.* 650,784.

A self-sustaining resinous film, at least part of one surface of which is undulated, is made by forming on a carrier a layer of an organosol, comprising a vinyl resin and a dispersing agent, applying a swelling agent to the layer while on the carrier under such conditions as to produce undulations in it, drying the layer, and stripping it from the carrier. The layer may be fused before stripping, and the layer of organosol may be formed on a transparent or light-reflecting sheet and allowed to remain bonded to it. The vinyl resin may be a copolymer of vinyl acetate and vinyl chloride, and the organosol may consist of a plasticiser and a vinyl resin in the ratio of 0·15–1·10 : 1. The swelling agent is a solvent containing 0·5–10% by weight of resin and may contain colouring material. The organosol may be applied as a layer of non-uniform thickness, and the swelling agent may be applied to part only of the layer, or to the whole area in non-uniform amount. If the organosol is diluted, part of the diluent is removed before applying the swelling agent. Either or both organosol and swelling agent may contain a phosphorescent or fluorescent material. S. V. S.

**Flexible Film.** M. A. Chavannes. *B.P.* 650,786.

Flexible film having on one face an undulated area is produced by applying to a carrier a dispersion of a resin in a fluid vehicle to form a continuous layer, of irregular thickness if desired, of a film-forming substance, e.g. a vinyl acetate–vinyl chloride copolymer, a plasticiser, and a diluent, the ratio by weight of plasticiser to vinyl copolymer being 0·15–1·10 : 1, and the carrier being less absorbent in at least one area than in other areas, applying a swelling agent to the exposed surface of the layer, and drying and stripping it from the carrier. The absorbent nature of the carrier is varied by applying a design of a relatively non-absorbent film-forming substance to a selected area of the carrier, the continuous layer of film-forming substance being applied to the carrier over the design and afterwards being stripped off with the latter. A layer of a porous substance, e.g. a clay, casein, and glycerol mixture, capable of providing a smooth absorbent surface, may be applied before the design is applied. Several designs of film-forming substance including at least one non-absorbent component may be applied, and one of the layers may include a phosphorescent or fluorescent component. S. V. S.

**Polyesters.** I.C.I. Ltd., O. B. Edgar, and E. Ellery. *B.P.* 650,358.

Polyesters suitable for use as flexible films and coatings of low brittle points are prepared by condensing bis-hydroxyethyl terephthalate (1 mol.) with either bis-hydroxyethyl adipate or sebacate (1–2·4 mol.). E. C.

**Polyester Plasticisers.** Carbide & Carbon Chemicals Corpn. and W. M. Lanham. *B.P.* 650,436.

Plasticisers with improved resistance to extraction and migration are prepared by condensing 2-ethylhexane-1:3-diol with an aliphatic dicarboxylic acid of 4–10 C to produce liquid polyesters. The diol may be partly replaced by a polyethylene glycol. E. C.

**Alkyl Acrylate Resins.** Dunlop Rubber Co. Ltd., F. A. Jones, W. Cooper, and R. H. Shrimpton. *B.P.* 651,355.

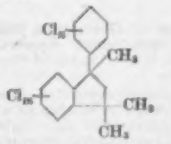
Elastic resins of good resistance to ageing at elevated temperatures are obtained by treating a mixture of an alkyl acrylate (Alk < 4 C), an alkyl acrylate (Alk > 3 C), and > 10% of a polymerisable compound containing two unconjugated double bonds, e.g. diallyl acetal. W. G. C.

**Stable Melamine–Formaldehyde Resins Completely Miscible with Water.** American Cyanamid Co., H. J. West, and W. T. Watt. *U.S.P.* 2,529,856.

A polymethylolmelamine is treated with methanol in presence of acid until a clear solution is produced. This is then neutralised and preferably made alkaline, and concentrated by distillation in high vacuum until the concentration of resin solids is not < 80%. The resulting syrup if further concentrated yields a clear, water-white solid resin on cooling. Both the syrup and the solid resin are completely miscible with water. C. O. C.

**Chlorinated Indane Derivatives—Plasticisers.** Standard Telephones & Cables Ltd. and A. J. Warner. *B.P.* 651,528.

Compounds of formula—




($m$ and $n$ = 0 or whole numbers, $m + n < 10$) are useful as plasticisers for synthetic resins, particularly for cellulose derivatives, polymerised unsaturated hydrocarbons, polystyrene, and polyvinyl chloride. C. O. C.

**Siloxane Resins.** Dow Corning Corpn. and E. J. Smith. *U.S.P.* 2,528,615.

A resinous siloxane containing 10–40 mol. % of monomethylsiloxane units, 9–20 mol. % of monophenylsiloxane units, and 40–70 mol. % of methlyphenylsiloxane units, in which the Si atoms are linked together by an alternating lattice of O and Si, on curing yields flexible, tough, and extensible enamels, suitable e.g. for coating wire. C. O. C.

**Organopolysiloxane Resins.** Dow Corning Corpn. *B.P.* 651,699.

Addition of an aluminium alkoxide to a liquefiable organopolysiloxane produces a heat-hardenable resin which is not brittle. C. O. C.

**Polytetrafluoroethylene Coatings.** du Pont. (V, p. 284.)

**Pentaerythritol Polyesters— Coatings.** I.C.I. Ltd. and S. F. Marrian. (V, p. 284.)

**Silicone-modified Alkyd Resins.** British Thomson-Houston Co. Ltd. (V, p. 284.)

**Solutions of Acrylonitrile Polymers.** American Viscose Corpn. (VI, p. 287.)

## XIV— ANALYSIS; TESTING; APPARATUS

**Colour Reaction for the Estimation of the Quality of Distilled Water.** V. I. Kuznetsov. *Priroda*, **40**, 55–56 (Feb. 1951).

The azo pigment (*C.I.* 189), formed when diazotised 2-aminonaphthalene-1-sulphonic acid is coupled with $\beta$-naphthol, forms sparingly soluble salts with all inorganic cations, including sodium and potassium. Its salts are yellow in soln., but red in the solid state. It may be applied in the form of its soluble pyridine or triethanolamine salt as a reagent for traces of inorganic ions in water. The reagent consists of a saturated soln. of the pigment in a 0·5% alcoholic soln. of pyridine. This (1–2 drops) is added to 1 ml. of the water under test. In pure water a permanent clear yellow coloration results, but in presence of traces of inorganic ions the initially yellow colour rapidly becomes reddish. Moscow tap-water still gives a distinct reaction after diluting 50 times with distilled water. The reaction may be used e.g. for checking the washing of certain precipitates, and for testing the leaching action of water on glasses and glazes. A. E. S.

**pH Standards of High Acidity and High Alkalinity and the Practical Scale of pH.** R. G. Bates, G. D. Pinching, and E. R. Smith. *Bur. Stand. J. Res.*, **45**, 418–429 (Nov. 1950)— *Research Paper* 2153.

The practical pH scale is deficient in standard buffer solutions at high and low pH ranges. It is in this range that junction potential errors are most likely to occur. The magnitude of these errors has been determined by comparison of cells with and without liquid junctions, and the pH values normally obtained were found to be low by 0·02–0·05 unit above pH 11 and either high or low by up to 0·03 unit below pH 2·5. The following additional standards were selected to supplement those already available—

(1) 0·01 M. Potassium tetroxalate— pH 2·15 at 25°c.
(2) Potassium hydrogen tartrate (saturated at room temperature)— pH 3·56
(3) 0·025 M. Sodium hydrogen succinate + 0·25 M. sodium succinate— pH 5·40
(4) 0·025 M. Sodium bicarbonate + 0·025 M. sodium carbonate— pH 10·02.
(5) 0·01 M. Trisodium phosphate— pH 11·72.

W. J. M.

**Froth Formation of Detergents and Auxiliary Products. II— Improved Apparatus for Testing Frothing.** E. Götte. *Melliand Textilber.*, **32**, 210–212 (March 1951).

A new fully automatic apparatus is described which tests the frothing properties of substances which lower surface tension. An examination of pure sodium alkyl sulphates with this apparatus showed that their resistance to frothing reaches its maximum at the critical concentration for the formation of micelles, whilst the volume of the froth increases linearly with the logarithm of the concentration. B. K.

**Standardisation of Testing Methods for Textile Auxiliary Products.** G. Schwen. *Melliand Textilber.*, **31**, 855–856 (Dec. 1950).

This is a further report on the work of the technical committee of the Arbeitsgemeinschaft der Textilhilfsmittel-, Lederhilfsmittel-, und Gerbstoffindustrie. Consideration is given to the necessary conditions for the determination of the detergent properties of surface-active agents, and a method for the evaluation of wetting agents used in neutral, weakly alkaline, or weakly acidic solutions is specified. Wetting agents for use in mercerising and carbonising require special testing methods. H. K.

**Papyrographic (Paper-chromatographic) Separation of Dyes.** H. Zahn. *Textil-Praxis*, **6**, 127–130 (Feb. 1951).

After reviewing the literature, the results of experiments are described on the chromatographic separation of dyes by capillary tests on paper. 80% *iso*Butyric acid is an excellent solvent to use with acid, mordant, and premetallised dyes, and 60% ethylene glycol with dispersed dyes for acetate rayon, to facilitate separation. B. K.

**Quantitative Analysis of a Fast Colour Salt.** P. V. Gorshkov. *Tekstil. Prom.*, **11**, 29–30 (Jan. 1951).

To estimate the content of diazonium salt in the commercial Fast Colour Salt of Azoamin Blue O (Variamine Blue B), a soln. containing a known wt. of the material is titrated to neutrality with 0·1 N-NaOH. A further amount (an excess) of the alkali is added by pipette, and the soln. is boiled to decompose the diazonium salt completely (when it is converted quantitatively into a phenolic body with the evolution of nitrogen). The soln. is again titrated to neutrality (with 0·1 N. acid). Any suitable electrometric method of titration may be used. Thus, a cell may be set up with antimony electrodes, one in the soln., and one in an external neutral soln. Neutrality is then indicated by a null reading on a galvanometer connected across the electrodes. A. E. S.

**Hydrogen Bonding and Chromatographic Separability (Amino Compounds).** H. Hoyer. *Kolloid-Z.*, **121**, 121–129 (March 1951).

The chromatography of a large number of aminoanthraquinone compounds has shown that the ease with which isomers are separated is related to differences in their capacity to form intramolecular hydrogen bonds. F. A.

**Determination of the Degree of Polymerisation of Cellulose by Staudinger's Method.** "FaChemFa". *Melliand Textilber.*, **32**, 39–40 (Jan. 1951).

The Testing Commission of the Industriegemeinschaft Chemiefaser has published a specification for the determination of the degree of polymerisation of cellulose from its viscosity in cuprammonium hydroxide solution. H. K.

**Determination of Xanthate Sulphur and Trithiocarbonate in Viscose by Ultra-violet Spectrophotometry.** E. Schauenstein and E. Treiber. *Melliand Textilber.*, **32**, 43–47 (Jan. 1951).

During an investigation of the reactions of the viscose process it was established that xanthate and trithiocarbonate could be determined by means of the ultraviolet spectrograph to an accuracy of $\pm$ 10%. H. K.

**Amino Acid Analysis.** G. R. Tristram. *Chem. and Ind.*, **53**, S 868–S 873 (30th Dec. 1950).

Modern methods of amino acid analysis are reviewed, and include— estimation of hydroxyamino acids (serine and threonine), electrodialysis of basic amino acids, enzymatic decarboxylation, isotopic dilution, radioactive isotopic swamping, starch chromatography, determination of cysteine in intact protein, determination of dicarboxylic acids, colorimetric techniques, and end-group analysis by reaction with fluoro-2:4-dinitrobenzene. Critical consideration is given to the accuracy of different methods, and examples of numerous analyses are tabulated for comparison. It is concluded that the approx. accuracy of most methods is $\pm$ 3%, which limitation restricts attempts to put protein composition on an exact stoichiometric basis. J. W. B.

**Detection of Modification in Animal Fibres. I— Use of the Ratio (Hookean Slope in $H_2O$)/(Hookean Slope in Conditioned Air).** H. M. Burte. *Text. Research J.*, **21**, 63–66 (Feb. 1951).

A non-destructive test for the detection of modification

in animal fibres consists in determining the ratio (Hookean slope in water) : (Hookean slope in conditioned air), both measurements being made on the same fibre. This ratio is independent of fibre cross-sectional area, whilst fibre-to-fibre variation is small for a given fibre type and prehistory. The ratio is sensitive to chemical modification, and because of the low fibre variance it is possible to show statistically significant differences with a small number of samples. P. C.

**Rapid Method of Determining Ether Extracts.** J. C. Dickinson and R. C. Palmer. *J. Textile Inst.*, **42**, T 6–T 14 (Jan. 1951).

Greasy wool (2 g.) is extracted under controlled compression with 10 ml. of solvent in a piece of glass tubing 12 cm. × 12 mm., drawn to a capillary at one end. Emergent solvent drips on to a light aluminium tray (about 1 g.), which is clamped in a brass frame a short distance above a hotplate. Evaporation is rapid without solvent creeping. Worsted oil extraction is checked by control soxhleting and by open-tray evaporation of known oil solutions, and shows that this simplified procedure gives accurate and reproducible results. With woollen oils both this and the Soxhlet extraction are more erratic. J. W. B.

**Measurement of Static Electricity on Fabrics.** M. Hayek and F. C. Chromey. *Amer. Dyestuff Rep.*, **40**, P 164–P 168 (5th March 1951).

An instrument is developed which combines a machine for generating charges on fabrics and a means of measuring the charges. Test fabrics are mounted on a cylinder and charged by friction against a second surface, the charge being measured electronically. Working parts are housed in a metal box to permit humidity control. Tests are described on fabrics treated with antistatic agents, and it is shown that static propensities depend on the surface electrical conductivity. J. W. B.

**Measurement of Damage to Wool Fibres.** M. Robinet. *J. Textile Inst.*, **42**, P 20–P 22 (Jan. 1951).

Lots of wool are variously damaged by heating to different temp. for 30 min. in 0·1% $Na_2CO_3$ soln. Damaged samples are cut to small lengths (< 1 mm.) and stained with Pauly reagent, lactophenol blue, and Rhodamine B, fibres being divided into three classes—(1) unstained, (2) slightly stained, and (3) strongly stained. Rhodamine is unsatisfactory, and statistical analysis of results, supported by measurements made by independent observers, shows that lactophenol blue gives the best results. The $\chi^2$ (chi squared) test is applied as a measure of the difference between two distributions and shows that the biggest change in distribution occurs between 40°C. and 60°C., attention thus being drawn to the possible existence of a critical region of temperature in the treatment of wool in alkaline baths.

E. Kornreich. *Ibid.*, **42**, P 90 (Feb. 1951).

Robinet's attention is drawn to a previously published description of the use of lactophenol–cotton blue in the investigation of damage to wool fibres. J. W. B.

**Assessment of Alkali Damage to Wool.** M. Binder. *Teintex*, **16**, 13–31 (Jan. 1951) and 55–61 (Feb. 1951).

Suggested methods for assessing alkali damage to wool include microscopic examination, chemical tests, colour reactions, measurement of physical properties, and performance tests under controlled conditions. Published work on standard tests of the above types shows some divergence in the results obtained. Such tests are described in some detail, along with the results of work carried out by the author with the various tests in question. B. K.

**White Standard.** K. Miescher and R. Rometsch. *Experientia*, **6**, 302–304 (1950): *Chem. Abs.*, **45**, 1461 (25th Feb. 1951).

Barium sulphate precipitated from pure reagents and then pressed with a trace of gelatin in chromium-plated moulds gives an almost ideal white standard. The high reflectance of 0·991 varies only ± 0·002 throughout the visible spectrum. C. O. C.

**Measurement of "Whiteness" of Wool especially in the Loose State.** H. J. Selling. *J. Textile Inst.*, **42**, P 44–P 45 (Jan. 1951).

For estimating whiteness in regard to practical problems, e.g. the amount of bluing agent required, (*a*) the one-point reflection method, (*b*) Stephanson's method, (*c*) Harrison's method, and (*d*) measurement of brightness are used. Although there must be a definite amount of blue which produces a maximum whiteness of the surface under discussion, this maximum cannot be found by these methods. Accordingly an equation for whiteness is written—

$$W = 100 - \sqrt{\Delta H^2 + k\Delta s^2}$$

($\Delta H$ = difference in brightness between the ideal white surface and the almost white surface; $\Delta s$ = distance between the points representing these surfaces on a uniform chromaticity diagram, $k$ = a constant). When applied to various problems related to whiteness, there is good agreement with the average visual impression. Difficulties of applying practical measurements to whiteness of loose wool are discussed together with some suggestions for overcoming them. J. W. B.

**Relating Laboratory Data to Mill Practice.** A.A.T.C.C. Philadelphia Section. *Amer. Dyestuff Rep.*, **40**, P 84–P 100 (5th Feb. 1951).

A single- and multi-unit dyeing apparatus is described, in which wool may be dyed under controlled temperature and agitation, and the exhaustion rates studied. Experiments with acid and metallised acid dyes on wool and with acid dyes on bright filament nylon and spun-nylon yarn are described. Data are used to indicate level and unlevel dyeing characteristics, while by suitable manipulation of the apparatus factory conditions can be closely duplicated. J. W. B.

**Spectrophotometric Studies of Continuous Dyeing.** A.A.T.C.C. South-Central Section. *Amer. Dyestuff Rep.*, **40**, P 101–P 104 (5th Feb. 1951).

A simple and fairly precise method is described whereby spectrophotometry is applied to evaluate dye concn. in continuous dyeing under factory conditions. Data for a one- and two-colour vat and a three-colour direct bath are provided, with a simplified mathematical method of interpreting experimental results. J. W. B.

**Uniformity of Grading of American, British, and German Light-fastness Standards—A Reply to the Fastness Tests Co-ordinating Committee of the Society of Dyers and Colourists.** I. H. Godlove. *Amer. Dyestuff Rep.*, **40**, P 114–P 118 (19th Feb. 1951).

In reply to a criticism of the S.D.C. Committee (*ibid.*, **39**, P 912 (25th Dec. 1950)) concerning the use of the Adams formula for measuring the degree of fading of standards for light fastness, it is contended that the Adams formula is one of the best of the ten available. It is the most convenient, and is especially accurate for small colour differences when the change of hue is slight. American light standards are still held to be more uniformly graded than the European. A proposal that an agreement be reached with respect to an instrumental measurement of a "definite break" in fading tests is presented for committee work on light standards. It is also suggested that, using optical instruments, fastness ratings could be determined with one short and one long exposure of a set of light standards and a sample of unknown fastness. A method is proposed, based on Vickerstaff's work relating the fading of pigments to duration of exposure. J. W. B.

**Evaluation of Four Laboratory and Two Wear Test Methods for measuring Perspiration Colour Fastness in Rayon Fabrics.** P. B. Mack, M. V. Jones, S. Davison, and M. K. Knight. *Text. Research J.*, **20**, 862–869 (Dec. 1950).

Four methods of applying artificial perspiration to rayon fabrics have been compared. They were (i) the commercial standard test, (ii) glass plate test, (iii) roll, and (iv) glass rod methods. A series of seven periods of contact were used. Thirty-two textile fabrics were used, some of which were employed in human wearing tests. Method (i) was the least severe, but the remaining three methods all gave highly comparable results. Method (ii) employing a test period of 6 hr. (recently recommended in a Research Report of the A.A.T.C.C.) was compared with the results of the wearing tests and found to predict with reasonable accuracy damage occurring during actual wear. W. J. M.

**Correlation Studies of Accelerated and Natural Weathering Tests on Protectively Finished Cotton Duck.** P. J. Fynn, C. N. Daly, C. M. Fleming, and J. D. Dean. *Text. Research J.*, **21**, 116–123 (Feb. 1951).

Two series of samples of various types of weather-protection finishes applied to a common cotton fabric were exposed to accelerated weathering tests under conditions which were varied in attempts to obtain results most closely approximating to those of actual weather conditions. There was a positive correlation between accelerated and natural test results, but no constant relationship was found which would enable forecasts to be made from an accelerated test. The accelerated test cannot always discriminate between the very good and very poor specimens. P. C.

**Detection and Estimation of Damage in Jute Fibre. II— Assessment of Fungal Damage on Small Quantities of Fibre Material.** S. N. Basu and S. N. Ghose. *J. Textile Inst.*, **42**, T 1–T 5 (Jan. 1951).

An attempt is made to use microscopical tests, and determination of loss in weight of fibre material, in assessing the jute-decomposing capacities of individual fungal species. Strips of sterile jute hessian are each inoculated with a single species and incubated for 14 days; this is followed by strength testing and microscopic examination of chopped samples from the strength-test residues. Damage count is found to be a fairly accurate measure of loss in strength, being most sensitive below 40% strength loss. Experiments on jute yarn under different conditions also show a rise in damage count with loss in strength, though the rise is more rapid than in the experiment with hessian, showing that results are comparable only within the same experiment. Loss in weight of fungi-degraded samples of raw jute is measured and is found in general to be an index of damage, probably as the highest absolute loss in weight is suffered by the $\alpha$-cellulose portion. J. W. B.

**Method for the Quantitative Estimation of Copper with particular reference to Proofed Jute Fabrics.** W. G. Macmillan and P. C. Das. *J. Appl. Chem.*, **1**, 132–135 (March 1951).

Copper in the presence of excess ammonia is estimated volumetrically by titration at the boil against 0·1% glucose solution previously standardised with a copper solution under identical conditions. The end-point is the disappearance of the blue colour. Iron does not interfere, but large amounts obscure the end-point owing to the colour of the precipitated ferric hydroxide. The method is simpler and more economical than the iodometric method, and has been found useful for estimating copper in proofed jute fabrics. W. K. R.

**Testing of Fireproof Fabrics.** H. M. Ulrich. *Textil-Rund.*, **6**, 45–53 (Feb. 1951).

A short review of the processes used for producing fireproof finishes is followed by a review of the methods used for their identification and for evaluating their efficiency. F. A.

**Analytical Examination of Plasticisers obtained from Polyvinyl Chloride Compositions.** J. Haslam, W. Soppet, and H. A. Willis. *J. Appl. Chem.*, **1**, 112–124 (March 1951).

A summary is given of methods which have proved useful in identifying plasticisers isolated from polyvinyl chloride compositions, including qualitative and quantitative chemical tests and infra-red spectra. W. K. R.

**Substituted Benzidines and Related Compounds as Reagents in Analytical Chemistry.** R. Belcher and A. J. Nutten. *J.C.S.*, 544–551 (Feb. 1951).

**I**— Solubilities of the Sulphates (pp. 544–546)
**II**— Reaction with Oxidising Agents (pp. 546–547)
**III**— 3-Methylbenzidine and 3:3′-Diethylbenzidine as Indicators in Argentometry (pp. 547–548)
**IV**— Naphthidine as Indicator in the Determination of Zinc with Ferrocyanide (pp. 548–549)
**V**— New Indicators for the Microvolumetric Determination of Gold (pp. 550–551).

PATENTS

**Sampling Pipette for Hot or Poisonous Liquids.** Postans Ltd. and M. H. M. Arnold. *B.P.* 651,374.

A pipette suitable for hot or poisonous liquids has the upper end of the bore closed and an opening in the wall of the bore above the datum graduation. The pipette is filled by dipping into the liquid, and the level adjusted by placing the finger over the hole in the side of the bore. W. G. C.

**Photoelectric Colorimeter.** I.C.I. Ltd. and R. F. Denington. *B.P.* 650,298.

The sample being examined is illuminated with a beam of light normal to its surface. Photoelectric cells are arranged symmetrically relative to the illuminated area so as to receive light diffusely but not specularly reflected from the sample, the light falling on the cells being restricted for each cell to a selected portion of the spectrum and at least three different portions of the spectrum being selected. This avoids changing f filters and enables readings for the various wave-bands of light to be taken simultaneously. C. O. C.

**Determining Hair Thickness.** W. F. Toynbee and P. F. A. Grein. *B.P.* 650,953.

Hair thickness is measured by holding and guiding the hair between a pair of feeler elements, which are mounted in a block for movement relative to each other and in a direction transversely to the surface, the displacement due to the presence of a hair influencing the setting of a spring-loaded horizontal rod which carries a pointer. J. W. B.

## XV— MISCELLANEOUS

**The Permicron— a Unit of Wave Number.** N. S. Bayliss. *Nature*, **167**, 367–368 (3rd March 1951).

Most data on visible and ultra-violet spectra, particularly of solutions, are in practice expressed as wavelengths with the millimicron as a favourite unit, partly because sec.$^{-1}$ and cm.$^{-1}$ are inconvenient. The permicron is suggested as the number of waves *per micron*, being written as such, or $\mu.^{-1}$ or $/\mu$. For example, the absorption maximum of bromine (405 m$\mu$.) would be 2·47 permicrons, and spectra in the visible, ultra-violet, and near-vacuum ultra-violet regions are in the range 1–10 permicrons. The unit is easy to visualise, e.g. with reference to colloidal dimensions. J. W. B.

**Mildews of Textiles and Related Materials.** C. G. C. Chesters. *Research*, **4**, 102–106 (March 1951).

A review of the various types of mildew attacking textiles and plastics, the conditions under which they do most damage, and the various types of fungicides that have proved to be effective in giving protection against them; 19 references. C. O. C.

**Some Observations on the Number of Black Flies (Diptera, Simulidæ) landing on Coloured Cloths.** D. M. Davies, *Canadian J. Zool.*, **29**, 65–70 (Feb. 1951).

An investigation into the relative numbers of black flies alighting on different coloured cloths was carried out by field tests in Ontario. Comparisons with black cloth showed that dark blue was the colour most frequented, followed by dark brown, black, dark green, dark red, medium grey, and lastly white. The number of flies alighting varied with the intensity of the light reflected from the cloth and to a lesser extent the wavelength. Dark cloths with the highest reflectances of ultra-violet and violet wavelengths showed the highest landing percentages. B. K.

**Factors in the Attractiveness of Bodies for Mosquitoes.** A. W. A. Brown. *Nature*, **167**, 202 (3rd Feb. 1951).

The relative attractiveness of textiles differing in hue and structure for the *Aëdes* mosquito was studied by field tests in Canada. White clothing was found to be much less attractive than black at all light intensities in ratios varying from 1 : 4 to 1 : 10. Light shades of red and blue were less than half as attractive as dark shades. Green was less attractive than red or blue, blue slightly less than red in dark shades, and light blue slightly more attractive than pink. Satins proved less attractive than broadcloths or crêpes, and woven nylon considerably less than cotton shirtings and drills. B. K.

**Specification of Configuration about Quadricovalent Asymmetric Atoms.** R. S. Cahn and C. K. Ingold. *J.C.S.*, 612–622 (Feb. 1951).

PATENT

**Self-administering Colour Vision Test.** W. F. Grether. *U.S.P.* 2,528,513.

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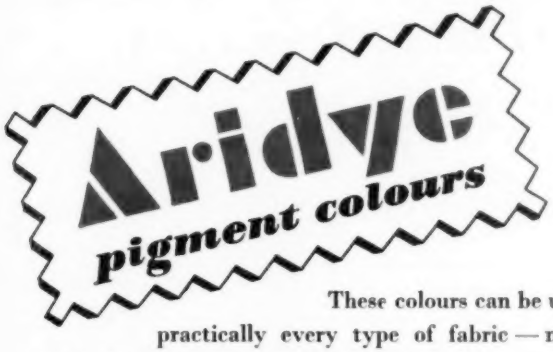


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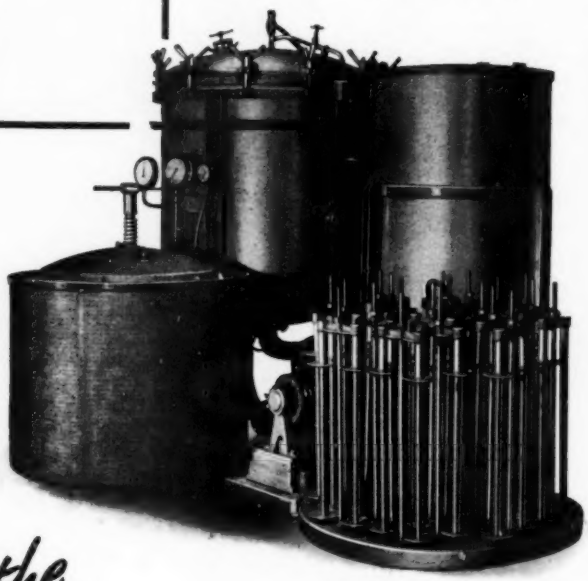

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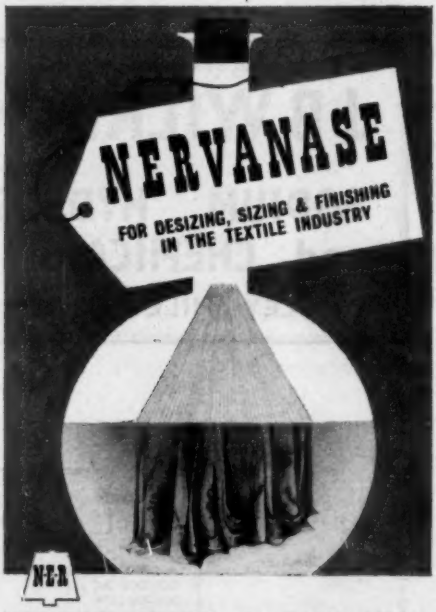


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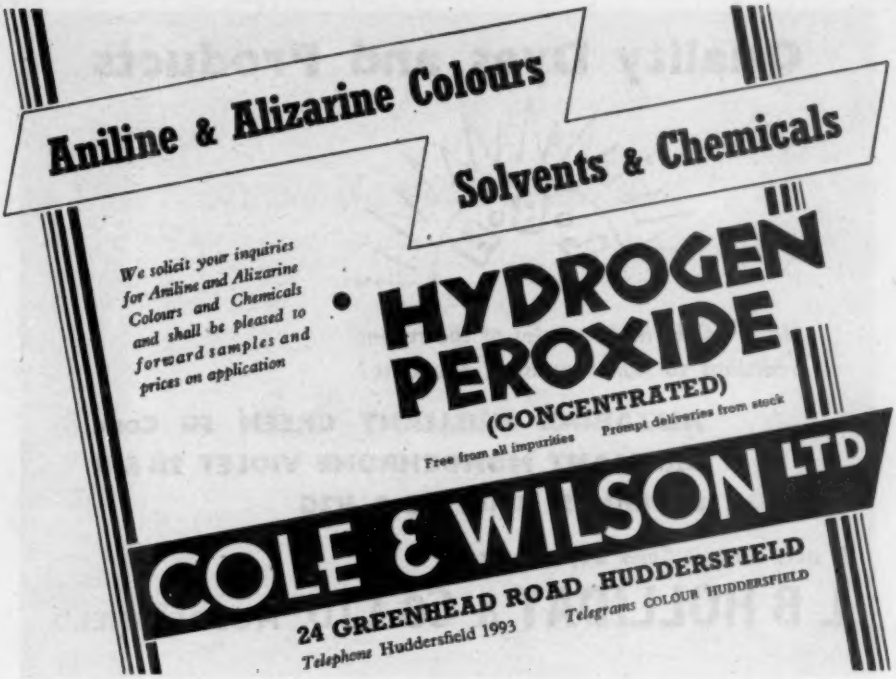
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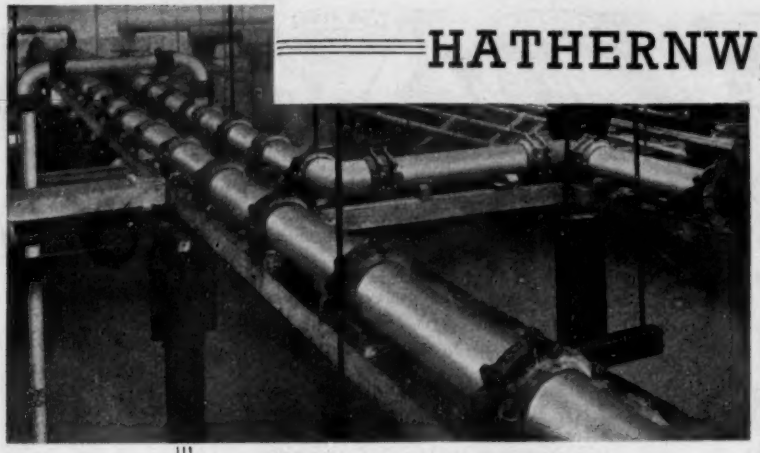

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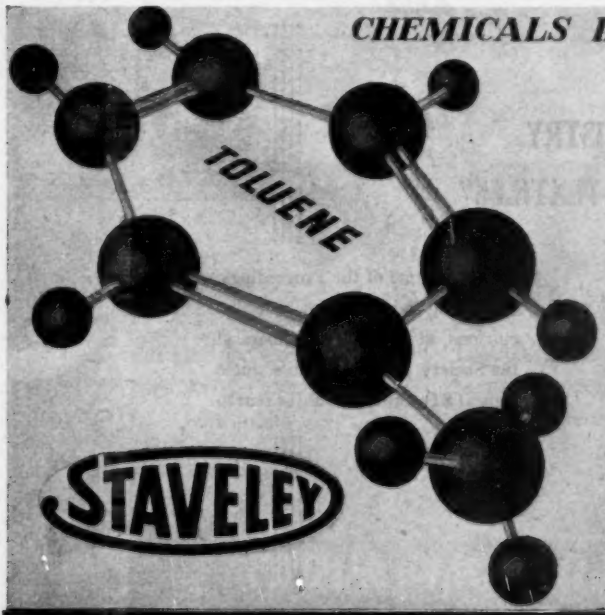


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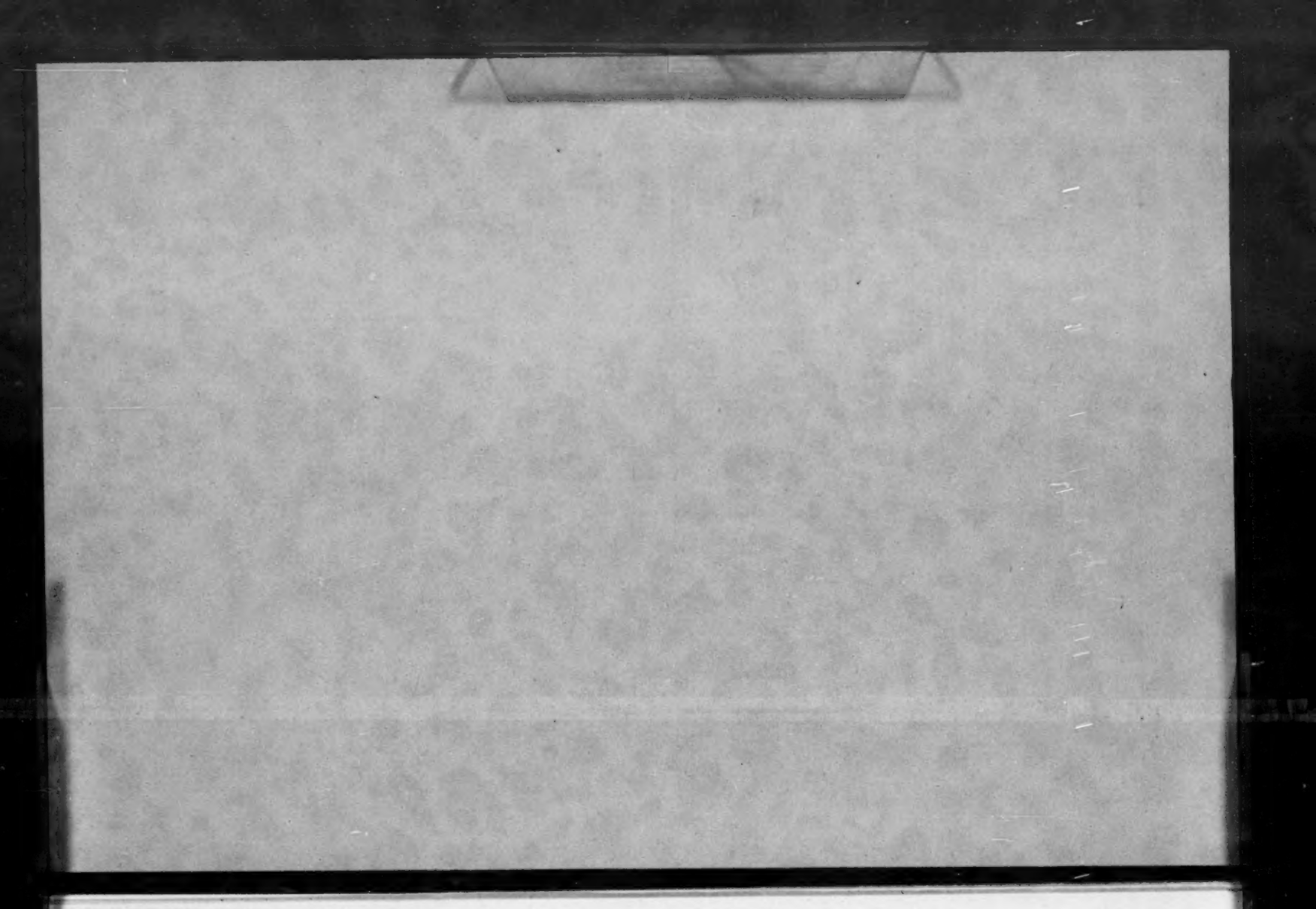

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